NOVEMBER 1958

# Agricultural Engineering

The Journal of the American Society of Agricultural Engineers

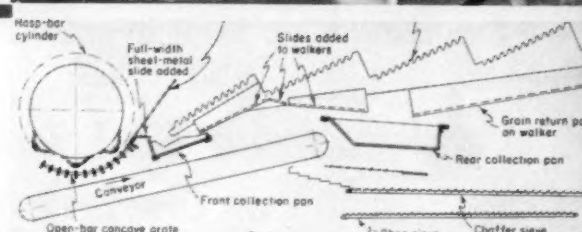

Approaching Automation in Hog Finishing | 692

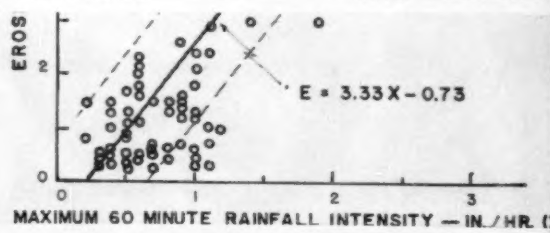
Performance Characteristics of Grain Combines | 697

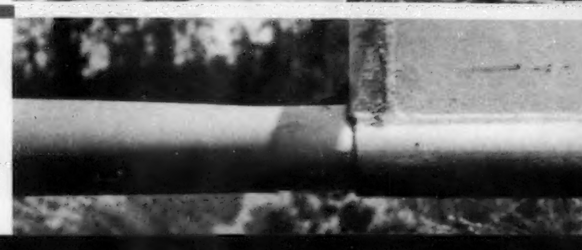
How Intense Rainfall Affects Runoff and Soil Erosion | 703

Engineering, Management and Marketing for Successful Farming | 708

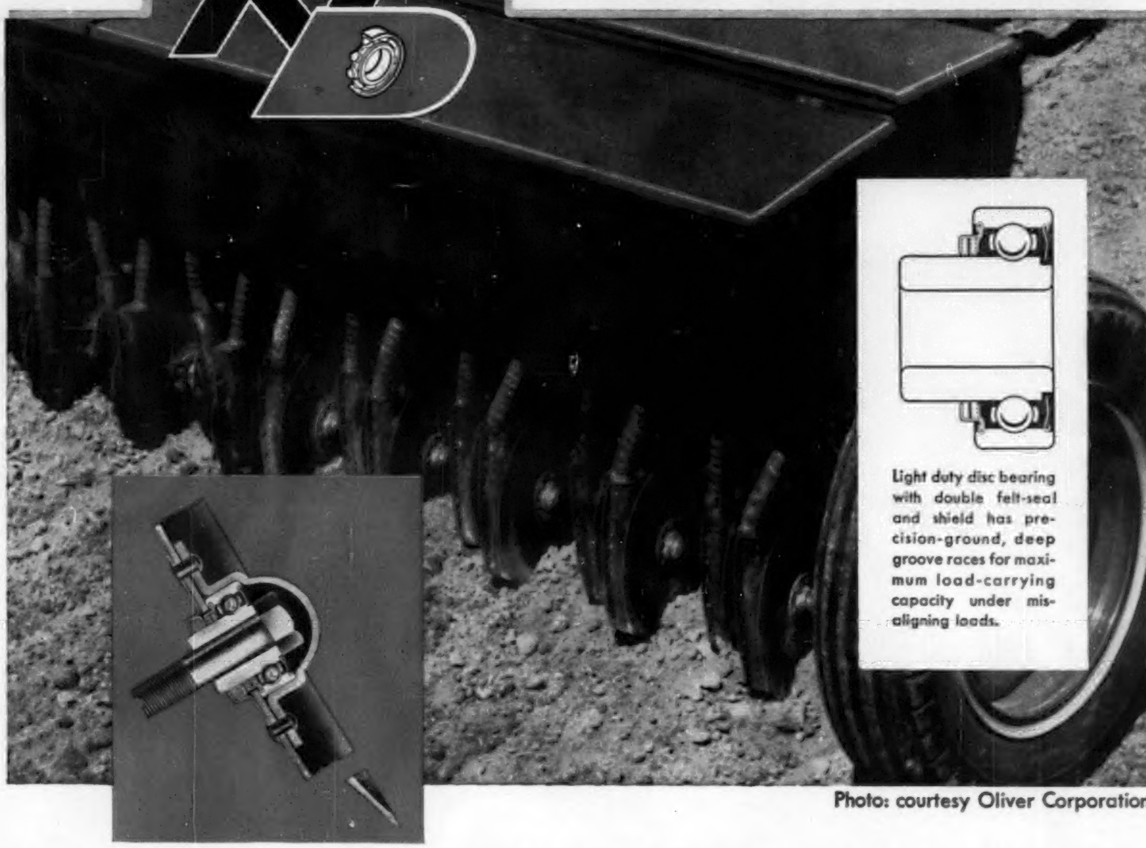
Machine Lays Plastic Drain | 712

# CASE HISTORIES



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# Agricultural Engineering

*Established 1920*

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JAMES BASSELMAN, *Editor and Publisher*



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## New Publication Soon

DURING the Annual Meeting of ASAE in June at Santa Barbara, California, the Council of ASAE approved publication of the TRANSACTIONS of the ASAE – the first edition to be released this fall. Since then articles representing each division of ASAE, with good geographic representation, have been selected with the help of critical readers and the members of the executive committees of each division. Copy has been sent to the printer and first copies of the TRANSACTIONS will be in the mail during the month of November.

The first edition will be distributed to all members and subscribers and will consist of 96 pages plus cover. Funds to support this edition will come from the Society's reserve fund. Subsequent editions will be larger in total pages and will be offered for sale to subscribers and, at a lower rate, to members of ASAE. Actual size of later editions will be determined by the number of advance orders, since income from subscriptions, above basic publication costs, will be used to increase size.

The purpose of the TRANSACTIONS is to make more technical papers available in the printed form, than is possible in the present Journal. The new publication will be printed by letter press on high-quality paper. It is intended as a companion publication to the Journal, to carry important agricultural engineering literature which has permanent value and which should be recorded for present and future reference. Its acceptance will permit more emphasis to be placed on broad interest and timeliness of publication for articles to be used in AGRICULTURAL ENGINEERING.

Arrangements are being made for indexing of the new publication by both Engineering Index and Agricultural Index. All libraries regularly receiving AGRICUTURAL ENGINEERING will also receive the first edition of the TRANSACTIONS.

In order to determine press run and page size estimates for the second edition to be published in the spring of 1959, provision for ordering copies has been included on membership dues and subscription invoices. Order blanks will also be included with the first edition when mailed to subscribers. Since the press run will be based on advance orders, delivery cannot be guaranteed on orders received after March 30, 1959. Price of the second edition containing at least 128 pages is $2.50 to members, $5.00 to all others.

Introduction of the TRANSACTIONS and the action taken by the Council of ASAE at the Santa Barbara meeting was prompted by the many requests for additional publication space made by ASAE members from time to time, and as a partial solution to a long recognized problem that faces ASAE as well as other professional societies. Its success will depend upon acceptance and demand.

## Radio Tribute Planned

THE ASAE will be saluted by Alex Dreier in a tribute to the farm equipment industry and the field of agricultural engineering on a nationwide radio program Nov. 23 at 6:05 (EST) over NBC-Monitor network. Presenting the program as one in a series of its kind honoring American fields of activities, he will also feature the Farm Equipment Institute and the National Retail Farm Equipment Association.

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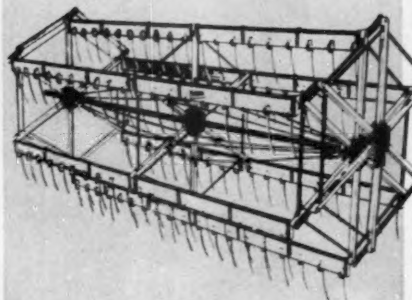

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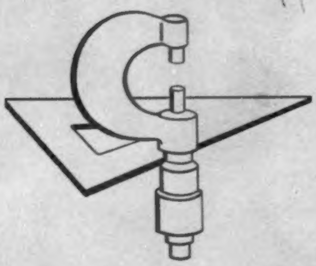

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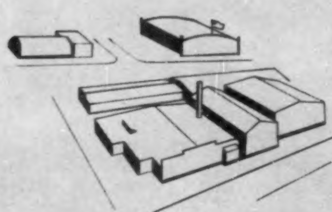

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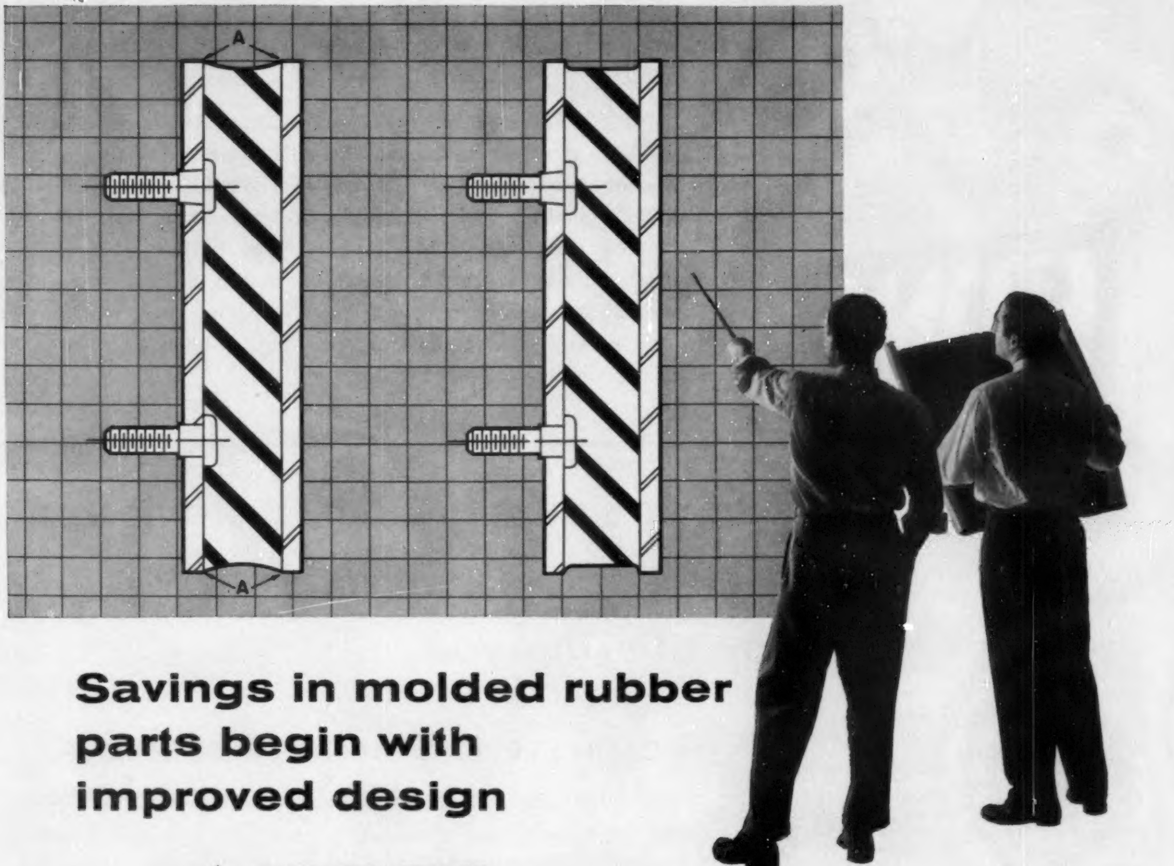


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Similar designs? Almost, but not quite. In the design at left, "A" is a stress point. The shrinkage of the rubber can cause concentrated strain at the edges of the bonded area. Ohio Rubber engineers would probably recommend the design shown at right.

Attention to important details like this is typical of ORCO's "customeering" of parts made from rubber, synthetic rubber, silicone rubber, polyurethane, and flexible vinyl, whether they be molded, extruded, or bonded to metal.

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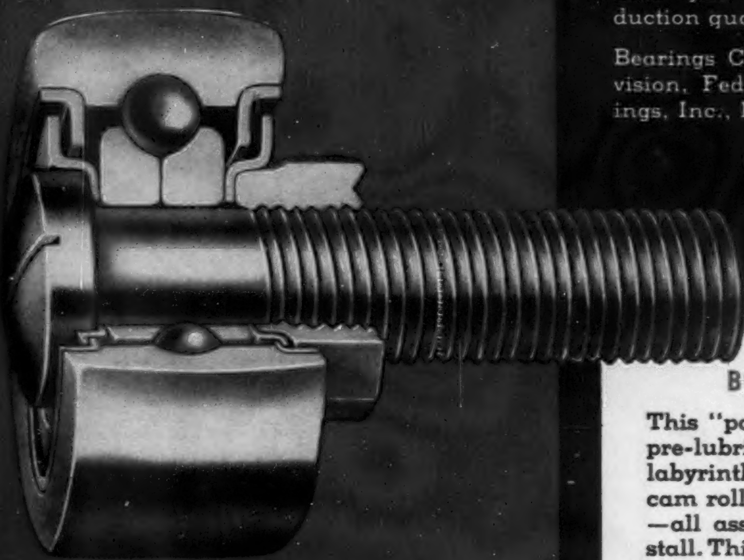

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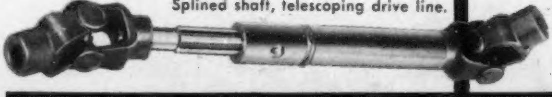

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## Report to Readers . . .

DRY-TYPE AIR CLEANER OPERATES AT CLOSE TO 100 PERCENT EFFICIENCY

One of the principal builders of diesel-engine tractors (Caterpillar) announces development of a new dry-type air cleaner of exceptional efficiency and simplicity. In extensive testing on such rugged applications as land clearing, construction and logging, it was found that the new cleaner would remove 99.8 percent of all dirt from the diesel's intake air. It has proven fully effective at any engine speed and is so designed as to speed servicing and reduce maintenance. . . . . A disposable, resin-impregnated cellulose filter, multicyclone precleaner, aluminum center tube, housing, and collecting trap comprise the cleaner unit. In operation, air is drawn through the stack cap, passes downward through the center tube and enters the precleaner. The precleaner is made up of two aluminum spirals and a group of vertical, funnel-shaped nylon tubes. . . . . Air entering the spirals begins to swirl, setting up centrifugal action, and dirt particles are forced to drop out of the nylon tubes into the collecting tray. About 95 percent of the dirt particles are removed at this point. The air then travels up through small aluminum tubes set inside the nylon funnel sections to the resin-impregnated cellulose filter element, which removes the dirt remaining. The clean air is then directed into the engine intake manifold. . . . . Servicing of the cleaner is simple and maintenance cost low.

BRITISH "CUBER" MAKES BOW IN FEED PELLETIZING DEVELOPMENT

Because of the rising tide of development in the USA of pelletizing forage crops for livestock feeding, the announcement of a farm cuber designed at Britian's National Institute of Agricultural Engineering is of special interest. The cuber, driven by electric motor, is designed for use with a continuous, automatic hammer mill. The feed mixture from the hammer mill is forced through "cubing" pipes by a hydraulic ram, at a capacity of over 224 pounds an hour. Heat for binding the compressed feed is produced by the pressure created as the ground materials are forced through the pipes. . . . . In the NIAE tests, mixtures with about 18 percent moisture and 4 percent molasses were used.

GEAR LUBRICANT PRODUCES STRINGY, WEBBING EFFECT

A characteristic that would appear to make it specially adapted to certain severe farm-equipment service requirements is the stringy, webbing effect of a new gear lubricant (Acrolite) soon to appear on the market. Instead of the usual film, this new grease forms an extremely tacky surface, and as the gear rotates, a stringy, webbing effect is produced which carries the lubricant from one gear-tooth face to another. This grease is a petroleum product and can be used on farm equipment or other gearing applications where a heavy-duty lubricant may be required.

PEA COMBINE SPEEDS UP HARVESTING OPERATION

A machine of British manufacture for harvesting the pea crop is equipped with lifters fitted to the cutter-bar assembly that lift the vines, which are then cut and elevated to the vining cylinders. There the pods are opened, and the shelled peas pass through a grille to a horizontal conveyor that carries them to the rear of the machine. From the conveyor, the peas pass through an air blast, which removes most of the foreign material, on to the cleaning conveyors. There final cleaning takes place, and the waste material is discharged at the rear of the machine, allowing the clean peas to fall into a cross conveyor which elevates them into trays for delivery direct to where they are to be canned, frozen or otherwise processed. The machine is being built under license in the USA.

**REMOVAL OF TREE FRUIT BY MECHANICAL SHAKING** Main problem in mechanically harvesting tree fruit is in separating it from the tree, which is best done by shaking the branches. How to mechanically shake trees so as to remove a maximum of good fruit with minimum power and tree damage is the basis of an active study by USDA and California (AES) engineers. These engineers point out three variables affecting removal of fruit: (1) frequency of shake (cycles per minute); (2) length of stroke of piston actuating the boom shaker; (3) force required to remove fruit divided by weight of fruit (F/W), and (4) number of fruit-bearing branches in any given tree. . . . . The engineers reported tests, with a 20-foot tractor-mounted boom shaker, at frequencies from 400 to 1,000 cycles per minute and at strokes of 1/2, 1, and 1½ inches. . . . . Minimum tree damage occurred at 700 to 900 cpm. Increase in stroke length generally increased limb breakage. The higher the frequency, the smaller were the differences in percent of fruit removed by the three lengths of strokes. The most fruit was removed from the most rigid trees - i.e., trees with fewest limber fruit-bearing branches. . . . . Factors yet to be evaluated in fruit-tree shaking include power requirement, position of shaker clamp on limb, and the force required to remove the fruit divided by weight of fruit.

**MECHANIZATION OF CHERRY CROP HARVESTING NOW IN THE OFFING** Biggest stumbling block to success in harvesting cherries mechanically is bruising the fruit, which causes spoilage, scald, and an inferior product. But USDA (ARS) researchers appear to have made substantial progress both in increasing the rate of picking and in reducing the amount of bruising - and the key to their success is a minnow net! . . . . In one series of tests, the cherries were loosened from the tree with the fingertips and allowed to fall into a minnow net suspended on a frame under the tree, the net absorbing the impact of the fall. Cherries harvested in this way bruised only slightly, mostly from striking twigs or branches. In ten tests, net harvesting averaged 36 percent more cherries than did pail-picking during the same time. . . . . In other tests, ripe cherries were shaken from trees onto the net, and almost ten times more cherries were harvested in the same time as with pail-picking. These studies showed that one worker could harvest 100 lb of cherries in a little over 10 min. While branch shaking causes more bruising of the fruit, the faster speed of this method may outweigh the disadvantage of bruising, since labor is a major expense in cherry production. The researchers say it may be possible to cut labor costs about 90 percent by using the branch-shaking method and a net. They have also found that cooling cherries in ice water after picking will greatly retard spoilage and development of scald.

**MECHANICAL POWER TRANSFORMS COTTON CULTIVATION PRACTICES** The combination of mechanical power and improved accessory equipment, such as sweeps, shovels and rotary hoes, have greatly transformed cotton cultivation practices in more recent years. In addition, the newer machines are provided with adjustments by means of which they can be adapted simply and easily to the different stages of plant growth and to varying soil, plant, and general field conditions. Because of these improvements, cultivator travel rates, for example, are often as high as 4 and 5 miles an hour. . . . . To reduce or eliminate hand thinning and chopping of cotton plants, one method is to use seed of good quality and plant it to the correct stand with a planter that is accurately adjusted and calibrated. Another approach to the problem of eliminating hand thinning and chopping is application of pre-emergent chemicals at planting time. A third approach is to cross-cultivate the cotton with the proper sweeps at the time it would ordinarily be thinned by hand. Usually only this one cultivation is needed to thin the crop to a stand and eliminate the weeds. Use of a rotary hoe shortly after the cotton plants emerge and use of rotary-hoe attachments on the cultivator is another common and effective way of controlling early weed growth.

(For more facts circle No. 10 on reply card)




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# The Thankful Heart

If human hearts know shame,
Ah, then truly it must be
That this one blushes crimson.

To consider how these misered fists
Seize Heaven's every gift
As though it were deserved . . .

To think how this vain self,
In all its utter thanklessness,
Takes Life and Love
As its due heritage . . .
Makes unproved claim
To Sight and Sound
And Touch and Taste
And all of Life's endowments . . .

To reflect how this ungrateful mind
Dares trifle even its mean talents into dust . . .
Dares squander even one small skill,
And play the profligate with Time . . .

To know this petty creature that I am
Dares taking Beauty for its own,
Makes property of all the stars,
The sun, the earth, the very universe,
Deems Art its rightful slave
And Poetry its handmaid . . .

To know with what effrontery it deigns
To pilfer particles of Wisdom's fund
And make them playthings . . .
Make keys of friendships, coin of Truth,
And mold of Faith a luckpiece . . .

To ponder this . . .
To ponder this, and recognize too well
One's proud and selfish image there,
Reflected so in gross ingratitude . . .

Ah, then it is this heart must blush
And beat its tardy thanks—
Its sincere and humble thanks . . .

For this beggar's bag of blessings!

*"Praying Hands"*
*by*
*Albrecht Dürer*
*(1471-1528)*

*Thanksgiving, 1958*

**JOHN DEERE**
**MOLINE, ILLINOIS**

# Agricultural Engineering

November, 1958
Number 11
Volume 39

James Basselman, *Editor*

## Fifth International Congress of Agricultural Engineering

### Reports, comments . . .

MORE than 400 agricultural engineers representing most of the Western European nations and including delegates from North and South America, Africa, and Asia participated in the Fifth International Congress of Agricultural Engineering (CIGR) at Brussels, Belgium, September 29 to October 4, 1958. Belgium and France appeared to have the largest delegations, although Western Germany, the Netherlands, England, Italy, and Spain were represented by impressive groups. Twelve agricultural engineers, headed by ASAE President McKibben and Vice-President Hurlbut, gave the United States its first official contact with the CIGR in more than 20 years.

The meeting, quite unlike a typical ASAE meeting, opened with a general session which was followed by technical discussions and local tours. For the technical sessions, the delegates were divided into four Sections: I. Soil science with application in the field of agricultural engineering; II. Farm buildings and connected equipment; III. Agricultural machinery and rural electrification; and IV. Farm work and processing. Within each Section, a predetermined series of "Questions" comprised the agenda. Papers relating to the various questions were submitted in advance by authors, reproduced by the local arrangements committee, and distributed to the delegates as they registered. Delegates were asked to become familiar with the various papers in order to discuss or question them following a general review of all papers on a particular question by a "Reporter General."

All speakers used either French, German, or English, and facilities for simultaneous translation into the other two languages were provided by the arrangements committee. The problems and delays necessarily associated with a congress being conducted in three languages slowed the tempo of the meeting and emphasized the value of multilingual ability as a vital factor toward better understanding and expediency.

The courtesies extended the U.S. delegation by Mr. Blanc of France, CIGR Chairman, Messrs. Dricot, Petit, Laret, Crabus and Simon of Belgium, Mr. Aranda Heredia of Spain, Mr. Passerini of Italy, and Mr. Preuschen of Germany will long be remembered. Although ASAE is not a member of CIGR, President McKibben was invited to sit at the speakers' table and to address the group during the closing dinner, and he and the ASAE Executive Secretary were invited to various other functions attended by officers of the CIGR.

EDITOR'S NOTE: J. L. Butt, executive secretary of ASAE, prepared the above report, comments and impressions following his visit to the Fifth International Congress of Agricultural Engineering as ASAE delegate. The U.S. delegation, headed by ASAE President E. G. McKibben and Vice-President L. W. Hurlbut, also included Karl Butler, W. M. Carleton, A. W. Cooper, Carl W. Hall, Ralph W. Hansen, C. F. Kelly, L. H. Lamouria, W. A. Maley and D. D. Smith.

### and major impressions

**By J. L. Butt, Executive Secretary, ASAE**

"FIFTY percent of scientific literature is in languages which more than half the world's scientists cannot read."* One of the major needs brought into focus by the recent visit to agricultural engineering research institutions abroad, and to the Fifth International Congress of Agricultural Engineering (CIGR), was for more adequate translating and abstracting services to effectively digest and disseminate the vast amount of excellent research literature published in various languages.

"Secrecy in science makes for inefficiency and inbreeding," according to British physicist, Sir George Thomson. A certain degree of secrecy is obviously necessary where military considerations are involved; but "secrecy from neglect," brought about by the lack of an organized, concerted effort to lift the language-barrier shrouds from the world's published research contributions, is an indictment of our modern society.

A translating and abstracting service, coupled with some means of distributing the results to proper individuals, would eliminate much costly duplication and would save valuable time in preliminary investigations. The sharing of important research contributions would lead to an acceleration of developments toward more efficient use of farm labor, better processing and storage of produce, and increased production in food-critical areas. A service of this type might well be an internationally-sponsored activity with results available to agricultural engineers in each participating nation. Agencies, organizations, or foundations seeking to alleviate world hunger could well take a long, second look at this means of helping to increase world food supplies. Lack of this service is a decided deterrent to progress in the mechanization of world agriculture and to more efficient use of farm labor.

Furthermore, on the subject of our understanding foreign language technical contributions, much effort could well begin at home. Former Secretary of Health, Education and Welfare Marian B. Folsom has been quoted as saying, "The United States is probably weaker in foreign language abilities than any other major country in the world." This was the second major impression apparent to the United States delegate to the recent CIGR meeting. Representatives of practically all other nations appeared to be proficient in at least two languages, sometimes four or five. This multilingual ability resulted in a much better opportunity to appreciate and understand the full significance of the Congress proceedings than was the case for the delegate who found it necessary to depend upon the secondhand reporting of an interpreter. The size of the world, measured in time units, has been reduced another fifty percent as a result of the dawning of the jet age of travel. The agricultural engineer of tomorrow would be well advised to equip himself for leadership in this consolidating international community by becoming proficient in several of the important languages of the world.

A third major impression of the value of international exchanges is one that has been stated so many times as to sound trite; yet it is one which might well be considered the most important of all: That of personal contacts and friendships which are developed during a visit or meeting and which transcend far beyond the immediate technical questions under consideration. Such friendships lead to stimulating discussions which sharpen the mind, to further exchanges of information and ideas which are essential to technological progress, and to better understanding, the keystone of world peace.

To this observer, these impressions — need for more satisfactory literature exchanges, importance of multilingual ability, and value of international professional friendships — were dominant. Agricultural engineers might well consider them in developing curriculums, in deciding upon participation in future international congresses, and in the development of programs of action by the ASAE. To do less would be turning away from opportunities on the horizon.

*Scientific and Technical Translating, UN Educational, Scientific and Cultural Organization (Columbia University Press).

### CIGR Meeting in the U. S.?

Considerable interest was expressed in holding the next CIGR meeting in the United States, in Washington, D. C., in 1962, at or near the time of the ASAE annual meeting. Many problems must be

*(Continued on page 712)*

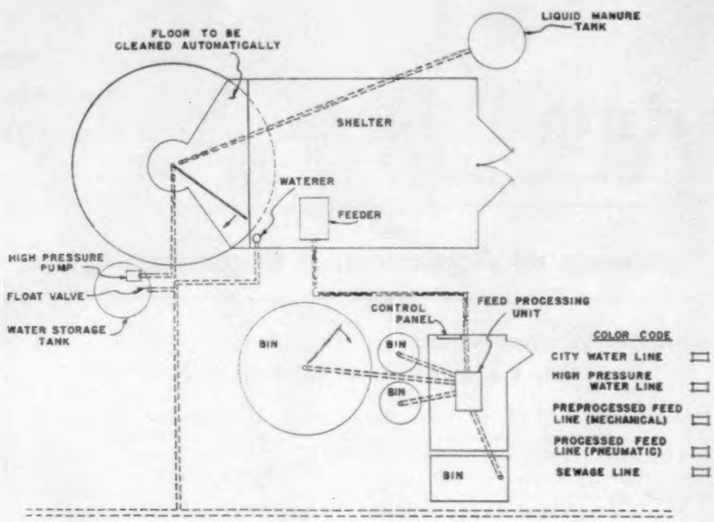


Fig. 1 *(Left)* Plan view of the automatic hog-finishing system

# Approaching Automation in Hog Finishing


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***Feeding, cleaning and waste disposal in a confined hog-finishing system are done under automatic control***

SUCCESSFUL mechanization of the production of field crops has drawn attention to the lack of mechanization in livestock production. According to the Agricultural Statistics of 1956, published by the U.S. Department of Agriculture, there has been a 300 percent increase in production of field crops per man-hour and only an 18.6 percent increase in the production of livestock products per man-hour since 1939. The high production of field crops per man-hour was brought about by the successful mechanization of production operations. The present methods used in the production of broilers are a good indication of what is to come in the production of other livestock.

Raising hogs in confinement is made possible through improved sanitation and management practices. It greatly increases labor requirements and increases the need for automatic operation to keep production costs at a level which will permit reasonable returns on the investment. Raising hogs in confinement not only brought about the need for automation; it made automatic operation more feasible by concentrating the animals in a smaller area and permitting arrangement of the environmental, feeding, and cleansing facilities to better suit the use of automatic devices.


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A project was initiated at the University of Illinois to determine the engineering requirements of a hog-finishing system to eliminate manual labor. The project covered three phases — that of feeding the hogs, cleaning the pen and maintaining sanitary conditions, and disposing of waste. A fourth phase covered all three of the preceding — that of arranging facilities for the most satisfactory operation (Figs. 1 and 2).

## Feeding System

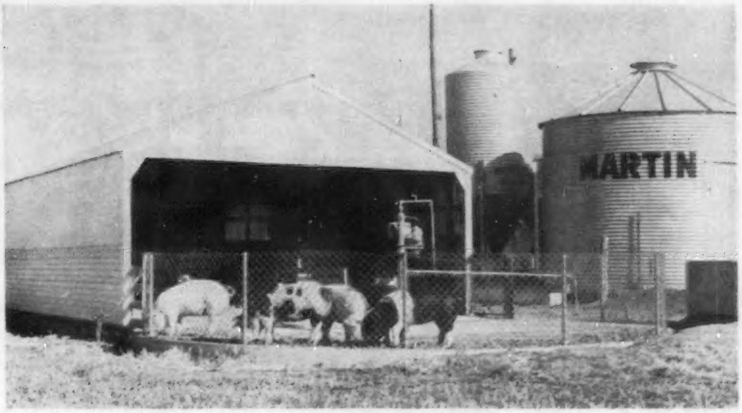
The feed-preparation system is completely automatic. Feed materials are stored in large bulk-storage containers. Feed is automatically delivered to a blender, a grinder, and finally to a conveyor which delivers it to the hog feeder. No manual operations are required for the delivery of feed beyond that of filling the bulk-storage bins. Every operation is under automatic control.

The feed-preparation system consists of four parts. Bulk-storage bins with unloading augers supply feed from the bins to an automatic mill. The mill is a commercial automatic mill with self-contained ingredient meters. An experimental high-pressure pneumatic conveying system conveys the feed. An experimental auger feeder distributes the feed before the hogs.

Several bins were used to evaluate their performance in a completely automatic feed-preparation system. Hopper-bottom bins and a flat-bottom bin with a special unloader* were used. This was an auger-type unloader developed at

*ARS 42-17, A New Automatic Unloader for Flat-Bottom Bins.

Fig. 2 *(Right)* Automatic hog-finishing system




the University of Illinois. A third experimental bin had the bottom in full tension and used an auger in the bin bottom to facilitate complete unloading.

Augers used to convey material from storage to grinding mill were commercially available types in common usage. They are nominal 4-in. augers. Small hoppers were installed above the grinding mill meters and equipped with switches to operate the supply augers. Whenever the hoppers were partially emptied, the switch would turn the supply auger on to refill the hopper. Each of these hoppers held only a small amount of material (Fig. 3).

The auger type blenders are an integral part of the grinding mill. Four meters are in the blender. The grinder is a 2-hp hammer mill (Fig. 4).

A high-pressure pneumatic conveyor is used with this system to provide flexibility and easy control of feed distribution. This type of conveying system is used widely in industry for maximum ease of handling powdered or granulated materials. However, the smallest type used in industry has a much higher capacity than that desired for this feeding system. One ton per hour will be sufficient distribution capacity for this feeding system.

A small feeder valve from an industrial system is used to place the feed into the conveying line (Fig. 5). It had a 1½-in. discharge opening which was reduced to a 1-in. diameter. The reason for reducing the conveying pipe size to 1 in. was to reduce the volume of air needed for conveying.

Feed flow is easily controlled with the high-pressure pneumatic system. A series of flow valves (Fig. 6), properly connected, can deliver feed to any reasonable number of feeders. Feed flow to each outlet can be easily regulated from a central control. This flexibility makes the high-pressure pneumatic conveying system desirable. The feed-conveying pipe is installed underground for convenience. Feed is conveyed much the same as water piped about the farmstead. The feed flow-diverter valves are the type referred to as pinch valves. The valve consists of a collapsible tube and a rigid outer casing. Air is forced into the area between the liner and the outer wall of the valve to collapse the liner. This stops feed flow. A small amount of feed accumulates on the upstream side of the valve, but if this is kept small, it interferes only momentarily with the flow of feed when the valve is opened. Pressure of approximately 40 psi is applied to the flow-diverter valve by a 4-way solenoid valve. This air pressure is supplied by an auxiliary compressor unit.

The feed distributor is experimental and was developed to operate either as a self-feeder or as a limited feeder. It consists of a small hopper, which receives the material from the conveying system, and a distributing auger that takes the feed from the hopper and places it before the animals in the feed trough (Fig. 7). Three pressure switches control the feeder. Two of these switches control the operation of the feed-distributing auger, and the third the operation of the grinder-conveyor. The first switch on the auger-control circuit is located in the bottom of the feed hopper. This is a normally open micro-switch that will not permit the feed-distributing auger to operate unless there is feed in the hopper. The second switch in the auger-control circuit is at the end of the auger, and it is a normally closed micro-switch. It stops the auger when the trough is filled and starts the auger when the trough is emptied by the hogs. The third micro-switch is located on the side of the feed hopper and is a normally closed micro-switch. It signals the feed-grinding mill for more feed whenever the feed level in the hopper drops below the switch, and turns the mill off when sufficient feed has been delivered to the feed hopper. This third switch acts either as a flow control or as a safety, depending upon how it is connected into the mill

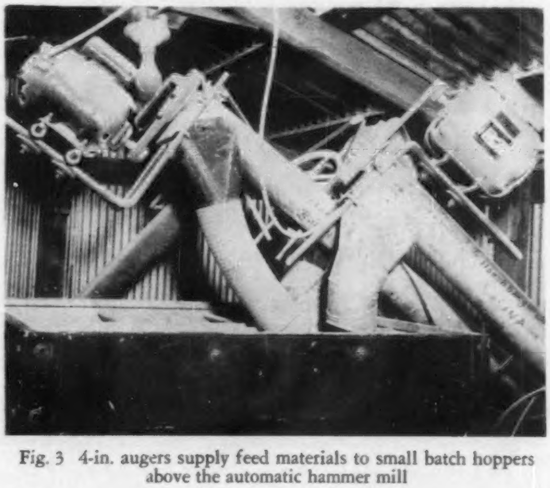


Fig. 3 4-in. augers supply feed materials to small batch hoppers above the automatic hammer mill

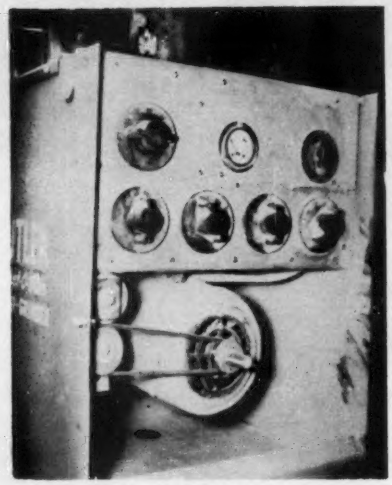


Fig. 4 The automatic 2-hp hammer mill has self-contained auger-type meters

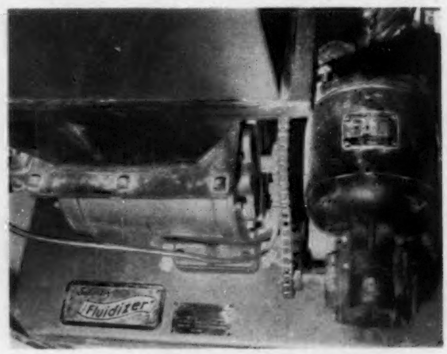




Fig. 5 The star-wheel feed and air mixing valve is mounted beneath the grinder

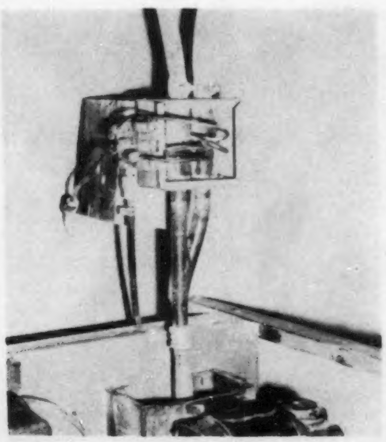


Fig. 6 A 1-in. pinch valve controls the direction of feed flow

control circuit. On limited feeding operation it acts as a safety and prevents the feed hopper from being overfilled by the mill. In a self-feeding operation it controls the delivery of feed and signals for feed from the grinding mill at any time the feed level in the hopper drops below the set level.

The feeding system is currently supplying two hog-feeding lots, the first being a part of the automatic hog-finishing system, and the second a self-feeder at a 200-ft distance from the feed-preparation center. A pressure of approximately 4 psi in the conveying system is required to deliver the feed to the hog self-feeder at the 200-ft distance. The conveying system is capable of operating at a continuous line pressure of 10 psi. It is reasonable to assume that this conveying system could deliver feed a maximum of 400 ft from the grinding mill. This would leave a small margin of safety to overcome line plugs. A larger compressor capable of operating at higher line pressures will convey feed farther than 400 ft. Maximum permissible operating pressure is the most critical limiting factor on the distance which feed may be conveyed.

### Cleaning System

Hydraulic cleaning of the floor appeared to be the most practical and the most easily controlled cleaning system. It was necessary to determine several factors regarding the use of a high-pressure water jet for cleaning. It was necessary to experiment with nozzle location, nozzle design, rate of water flow, and water pressure.

A 500-gal concrete tank is used as a water-supply reservoir for the cleaning system. It is filled from the regular water system and water flow is regulated by a float valve. A high-pressure, 2-hp turbine pump capable of delivering 800 gph at 100 psi pressure supplies water to the nozzles.

The nozzles are installed on a rotating boom that sweeps over the circular exercise floor (Fig. 8). It is supported by a post in the center of the floor. Water and electric service are provided through this post. A swivel joint permits the boom to rotate around the water-supply line. Several rotational speeds of the boom were used; approximately one-half revolution per minute is the most satisfactory speed.

Several flat spray nozzles discharging from overhead and at a slight angle toward the center were first used on the cleaning boom. These were unsatisfactory: too much of the force of the water was dissipated on the floor by splattering, and the spray did not wash the manure to the center as was desired. Two larger flat spray nozzles were then installed on the outer end of the boom at a level just above the floor. These did not work well. The force of the water spray was spread by the nozzle and did not provide sufficient force to float the manure to the center. The final arrangement used two nozzles located a few inches above the floor at the outer end of the boom, discharging a round solid stream. One nozzle was set to direct the water to contact the floor very near the outer edge. The second nozzle, trailing the first, was adjusted so that the spray would contact the floor about 3 ft in from the outside perimeter (Fig. 9). This nozzle arrangement did a good cleaning job.

It was found that at least 70 psi of water pressure are required to dislodge the manure and propel it to the center drain. A pressure of 90 psi exerted too much force and caused the manure to flow past the center of the floor, resulting in poor cleaning and excessively high use of water.

Fig. 7 An auger distributes feed from the small hopper to the trough

Each nozzle uses approximately 5 gpm of water at a pressure of 70 psi.

To prevent freezing of water in the nozzles and in the water line during extremely cold weather, an air bleeder was installed in the top of the line, and a gravity-operated valve at the lower end inside the water tank. This gravity valve did not work well and resulted in freezing and bursting of the line underneath the floor during a hard freeze. An alternate line was installed overhead and a solenoid bleeder valve was installed. This permitted fast bleeding of the water line and there has been no further trouble with freezing. When the water system shuts off, water drains from the center air bleeder toward the nozzles and back toward the pump. The line is clear of water in a few seconds.

The timer controlling the cleaning boom and the water pump is capable of 24 "on" and 24 "off" periods per day. The time of each period can be varied from 2 to 55 min. During the winter only two washings a day were employed — at 10:00 a.m. and at 3:00 p.m. No difficulty was encountered during the very cold weather with accumulation of ice on the floor. As the number of hogs increased, more frequent washings were required.

With 60 hogs, the pen was washed seven times a day. Starting at 7:00 a.m. it was washed every 2 hr until 7:00 p.m. Each of the washing periods lasted for 4 min. A 4-min washing period does not completely clean the floor, but it does remove approximately 90 percent of the waste. It would take twice as much water, or 8 min of cleaning time, to remove all of the waste from the floor.

**Floor and Shelter**

The concrete floor is 21 ft, 6 in. in diameter and slopes ½ in. per foot toward the center drain. It has a wood-float finish to give the hogs good footing.

The floor drain is a 4-in. hole only slightly below the floor level. A larger drain will be more satisfactory. It will be changed to intercept all wash water at the bottom of the slope and prevent its flowing past the drain.

Hogs have a habit of depositing droppings very close to the fence. It is necessary to have the nozzles outside the dropping area. Offset posts and an offset in the drop pipe place the nozzles beyond the droppings (Fig. 9).

Roof sections of aluminum will be used for shade during hot weather. Thermocouples installed in the floor will make it possible to evaluate the cooling effect of the washings. Available information shows that it is desirable to have a shelter over the outside floor during hot weather.

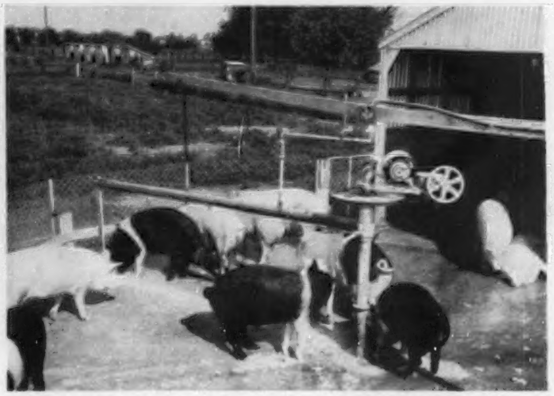


Fig. 8 The circular exercise floor is cleaned by a rotating spray

Tests indicate that less total space per hog will be needed if the whole structure is roofed and sidewalls are designed to control temperature the year round.

**Disposal System**

The washings from the floor are piped to a 500-gal septic tank through a 4-in. line. It is provided with a drain field and also an easy access to the top of the tank so that liquid manure may be withdrawn if desired. A septic tank with a drain field is convenient because it does not require immediate attention for removal of the liquid manure. At present we are using the septic tank principle only.

**Space Requirements**

It was desirable to get some information on the space requirements for hogs in a completely automatic confined hog-raising system. As a rough estimate, 10 sq ft of bedding area and 10 sq ft of exercise area were thought to be adequate. The unit was designed on this basis to accommodate approximately 30 hogs. In practice we have found that less space per animal is needed than was estimated. We have had as many as 60 hogs in the unit. Forty 250-pound hogs are the maximum desired number. We have also found that it is best to crowd the animals in the bedding area to prevent their messing up this portion of the pen, which cannot be cleaned automatically with the water spray. Temporary gates are installed to restrict the bedding area. Straw is not desirable as a bedding material; it will

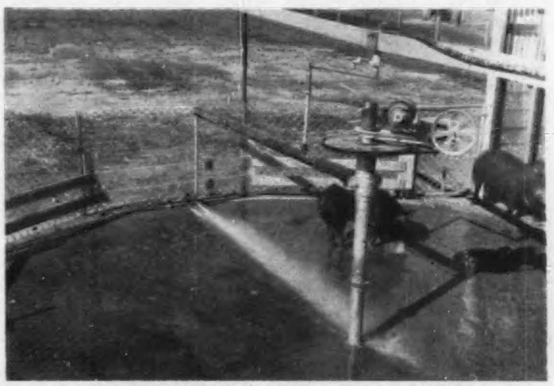


Fig. 9 Two nozzles on the spray boom, give good cleaning action

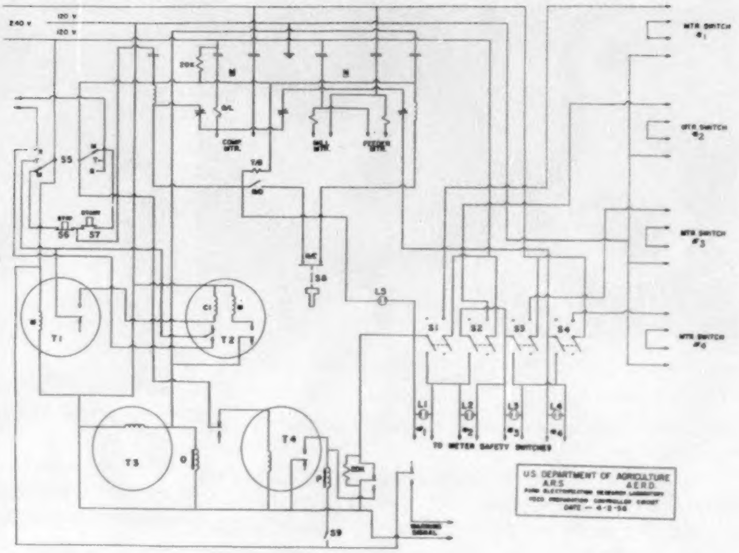



Fig. 10 Schematic of feeding system control circuits

plug the drain line. Only wood chips or crushed corn cobs are used for bedding.

### Feeding-System Controls

The control system consists of electromagnetic relays and several timers (Fig. 10). Two motor-starter relays are used – one for the compressor motor and a second for the feed valve and mill motor. Each motor has its own overload protector. The operation of the entire system is controlled by either a time clock or a feed-level switch in the feeder. The circuit is arranged so that any safety device can turn off the feed-processing system if trouble develops.

There are eight safety devices in the mill-control system. There is an overload protector on each of three motors, and a safety cutoff on each of four feed meters. If feed is not present in the meter, the safety switch will open and the grinding operation will stop. The eighth safety is a high-pressure cutoff which will stop the grinding mill and feed valve, but not the compressor, if a higher than usual pressure develops in the conveying line. Abnormally high conveying-line pressure is indicative of the formation of a line plug. It is necessary to stop the inflow of feed until the plug can be cleared. A time-delay relay will permit the grinding mill to be off for one minute before stopping the compressor. If the plug can be broken within this time, the operation of grinding and conveying will continue normally. If the line is not cleared within one minute, the entire system is shut down and a warning circuit is activated. This turns on a blinker light on the top of the feed-processing center. It could be wired to any desired type of visible or audible warning system and located at convenient places about the farmstead. If any one of the other seven safeties operates the entire system is turned off. Once the warning circuit has been activated, the mill cannot be started until the circuit is reset.

The mill is provided with three types of control. The first is manual, controlled by the normal 3-wire, 2-push-button control. The second is a 2-wire time-clock control. An operation timer is energized by a 24-hr time clock which delivers a short impulse at the desired feeding time. This energizes the operation timer, which is a 0 to 15-min interval timer. This interval timer is adjusted for the proper grinding time to deliver the desired amount of feed to the feeder. Two timers are necessary on this type of control because of the high-pressure cutoff safety in the grinding-mill circuit. This cutoff can interrupt operation of the grinding mill, resulting in underfeeding of the animals unless the timer is stopped when the mill is stopped. By use of two timers this is possible, and the operation timer checks only the operating period of the mill. The third method is a 2-wire control initiated by the feed-level switch in the feeder. This third system is utilized when the mill and the feeder are operated as a self-feeding unit. The mill delivers feed as is necessary to maintain the proper feed supply in the feeder.

### Results

The comparative gains of hogs on the experimental drylot facility, a dirt lot with the same mixed ration, and a dirt lot with corn and supplement free choice are given in Table 1.

TABLE 1

| | Dirt lot | Drylot facility | Corn and supplement free choice on dirt lot |
|---|---|---|---|
| Number of pigs | 13 | 13* | 13 |
| Avg. initial weight, lb | 115.1 | 114.2 | 114.9 |
| Avg. final weight, lb | 197.8 | 211.2 | 186.0 |
| Avg. daily gain, lb | 1.48 | 1.73 | 1.27 |
| Avg. daily feed per pig, lb | 6.19 | 7.53 | 5.35 |
| Feed per lb gain, lb | 4.19 | 4.34 | 4.21 |
| Feed cost per cwt gain | $10.14 | $10.50 | $9.92 |

*One pig died during the trial.

The average daily gain for the hogs on the experimental facility was considerably higher than that for the other two lots. The higher daily gain is ascribed to more comfortable conditions and free access to fresh feed and water at all times.

The high feed consumption on the drylot facility (7.53 lb per day) reflects some feed waste due to inefficient operation of the feeder. The feeder has been improved.

# Performance Characteristics of the Grain Combine in Barley

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***Intensive study of combine performance helps engineers recommend design improvements based on predicted combine behavior***

DURING the past nine years the California Agricultural Experiment Station has studied combine performance characteristics in a considerable number of different seed crops. The objectives of these studies have been twofold: *(a)* to determine the best adjustments and operating conditions for each crop in order to minimize seed losses and seed damage; and *(b)* to obtain basic information that might be helpful in understanding and predicting combine behavior and perhaps in improving combine design.

Although most emphasis has been placed upon small-seed legume studies(1)*, intensive field studies of combine performance in barley were conducted during the 1954, 1955, and 1956 seasons. These tests were initiated partly because of the importance of barley as a cereal crop in California and partly because of complaints from farmers that grain losses during harvesting were often excessive. Most of the tests were conducted with a 12-ft self-propelled combine loaned to the University by the John Deere Harvester Works and identified in this paper as machine No. S-1. Limited tests were also made on two other self-propelled machines and on several large, trailed machines equipped with raddle-type straw carriers and having built-in recleaners in addition to their regular cleaning shoes. Comparative specifications for the various harvesters are summarized in Table 1. All of the tests were made under the warm, relatively dry weather conditions typical of the interior valleys of California, with straw moisture contents usually not over 10 percent and seed moisture contents ranging from 7 to 9 percent.

TABLE 1. SPECIFICATIONS FOR COMBINES TESTED

| Machine type | Self-Propelled | | | Trailed | |
|---|---|---|---|---|---|
| Machine No. | S-1 | S-2 | S-3 | T-1, T-2, T-4 | T-3 |
| Header width, ft | 12 | 16 | 12 | 16 | 16 |
| Cylinder | | | | | |
| Type | rasp | rasp | rasp | spike | spike |
| Length, in. | 30 | 32 | 37 | 30 | 30 |
| Separating unit | | | | | |
| Type | 3 walkers | 4 walkers | 4 walkers | cell belt and raddle | |
| Width, in. | 30 | 37 | 37 | 38 | 36 |
| Length, in. | 130 | 128 | 124 | 159 | 160 |
| Cleaning shoe (chaffer sieve and chaffer extension) | | | | | |
| Chaffer type* | A | A | A | H | H |
| Width, in. | 28½ | 30½ | 35⅞₁₆ | 37¼ | 35 |
| Length (incl. ext.), in. | 54 | 56 | 48 | 61 | 53 |
| Recleaner | None | None | None | | |
| Width, in. | — | — | — | 37¼ | 35 |
| Length, in. | — | — | — | 28 | 28 |
| Calculated separating and cleaning areas, sq. in. | | | | | |
| Separator | 3900 | 4720 | 4600 | 6050 | 5760 |
| Shoe | 1550 | 1710 | 1700 | 2270 | 1855 |
| Recleaner | 0 | 0 | 0 | 1045 | 980 |
| Shoe and recleaner | 1550 | 1710 | 1700 | 3315 | 2835 |

*Chaffer types: A, Adjustable lip; H, 1-in.-mesh wire screen.

## Header Losses

To determine header losses, a canvas sheet was used to collect and move to one side all material discharged from the rear of the combine during 30 to 40 ft of forward travel. In this cleared area, shattered heads and seeds were picked up from one or more series of 1-ft by 2-ft areas outlined by a rod frame and distributed in a staggered pattern across nearly the full width of cut (five frame areas per series for a 12-ft header). Because the primary objective was to investigate the effect of reel adjustments, losses caused by the dividers at the ends of the header were not included. The results were adjusted for preharvest shatter losses.

All of the tests represented by Fig. 1 were performed in the same field on two successive days having similar weather conditions. These results show that high reel speed ratios (reel peripheral speed divided by forward speed) can cause excessive seed losses, particularly in upright grain. With either the fixed-bat reel or the pickup reel, speed ratios of 1.25 to 1.5 gave consistently satisfactory performance without excessive shatter losses. Increasing the ratio to 2.8 nearly doubled the header loss.

The top two solid curves in Fig. 1 show the effect of having a fixed-bat reel too low and perhaps too far forward, when operating in upright grain. The pickup reel was also too low and too far forward for upright grain. The heights indicated are for the lowest position of the bar (or tooth tips on the pickup reel) with reference to the cutting plane. The distance forward is from the tips of the knife sections to a line directly below the reel axis. A fixed-bat reel ordinarily should be 6 to 10 in. forward and at a height such that the lowest position of the bats is a little below the lowest heads. A pickup reel, when used in lodged crops, should be lower and a little farther forward.

On most combines the reel is driven from a power shaft that operates at constant rpm (assuming constant engine speed) and has no direct relation to the forward speed of the machine. Then, if the forward speed is reduced without changing sprockets or sheaves on the reel, the speed ratio increases in inverse proportion. As an example of the effect of excessive speed ratios, one of the commercially operated 16-ft trailed combines checked in 1955 had a constant-speed reel drive with a reel peripheral speed of 3.6 mph. This reel speed would have been satisfactory for a forward speed of 2½ mph, but the machine was operating in heavy barley

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*Numbers in parentheses refer to the appended references.

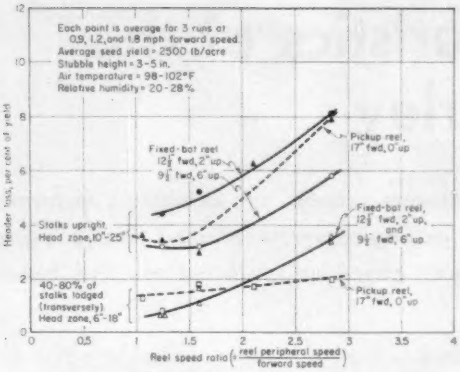



Fig. 1 Header loss in relation to reel speed ratio for 12-ft self-propelled combine (1955 tests)

## . . . Combine Performance

at a speed of only 1.1 mph which gave a reel speed ratio of 3.25. Installing different sprockets to give a ratio of 1.5, plus minor changes in the reel position, reduced the header loss from 400 to 100 lb per acre—a direct saving of over 2 tons of barley per day.

To simplify the problem of maintaining the best reel speed ratio under all operating conditions, it is recommended that the reel be driven from a ground wheel or from some shaft whose speed is proportional to forward speed. (This was done on self-propelled combine No. S-1.) With this arrangement it should seldom be necessary to change the speed ratio except for radically different crop conditions. Ratios of about 1.5 for fixed-bat reels and 1.15 to 1.25 for pickup reels should be satisfactory for most conditions. Although a constant-ratio reel drive would undoubtedly increase the cost of a combine, it is believed that this feature warrants further serious consideration by combine manufacturers. A constant-ratio drive is also highly desirable for windrow pickup attachments on combines, particularly when harvesting seed crops that shatter readily.

### Losses From Rear of Combine

The procedure for determining seed losses and feed rates was the same as that described by Bunnelle and his associates(1) in reporting earlier California studies pertaining to small-seed legume harvesting. In the following discussion, *feed rate* always refers to the total straw-and-chaff rate from the header (seed weight not included). Feed rates are based on the total weights of material collected from the walkers and from the shoe, less the total weight of free and unthreshed seed in each of these collections. *Seed yield* is considered to be the sum of all seed losses from the rear of the machine plus the seed delivered to the grain tank. It does not include header losses.

Fig. 2 shows typical curves of seed loss versus feed rate for 12-ft self-propelled combine No. S-1 in the 1955 tests. Note that the total loss increased rapidly when the feed rate exceeded 100 to 125 lb per min. In these tests, walker free-seed losses were somewhat greater than shoe free-seed losses, while unthreshed losses were relatively small.

Comparative capacities and seed losses for three large, trailed combines and three self-propelled combines are indicated in Fig. 3. The curve for machine S-1 was taken from

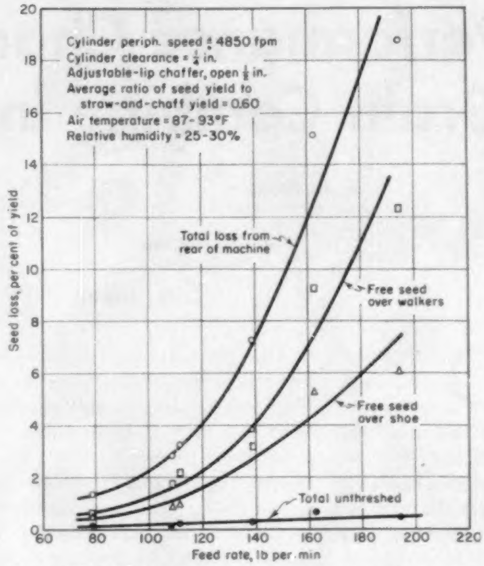



Fig. 2 Effect of feed rate upon seed losses from 12-ft self-propelled combine No. S-1 (1955 tests)

Fig. 2. These data indicate that, for a reasonable total rear-end seed loss of 2 to 4 percent, the trailed machines could handle 2 to 2½ times as much straw and chaff as could the self-propelled machines. If a straw-and-chaff yield of 2½ tons per acre is assumed and 25 percent of the total field time is lost in unloading, turning, adjusting, etc., the harvesting rates that represent 3 percent seed loss in Fig. 3 would be 1 to 1¼ acres per hour for the self-propelled combines and 2½ acres per hour for the trailed machines. Actually, all of the self-propelled machines were tested in fields having straw-and-chaff yields of about 2 tons per acre and the trailed combines were tested in a field where the straw-and-chaff yield was 3 tons per acre.

The trailed machines had only 35 percent more separating area than the self-propelled machines, 24 percent more area in the chaffer sieve and extension, and 85 percent more total cleaning area if the recleaner area is added to the chaffer area. Thus, the 100 to 150 percent greater capacity can be explained only in part by the greater separating and

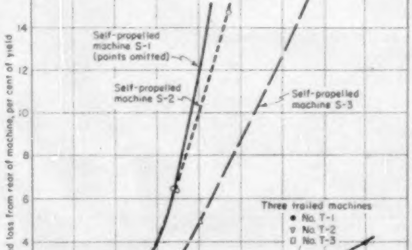



Fig. 3 Comparative seed losses and capacities for self-propelled combines and large, trailed combines (1955 tests)

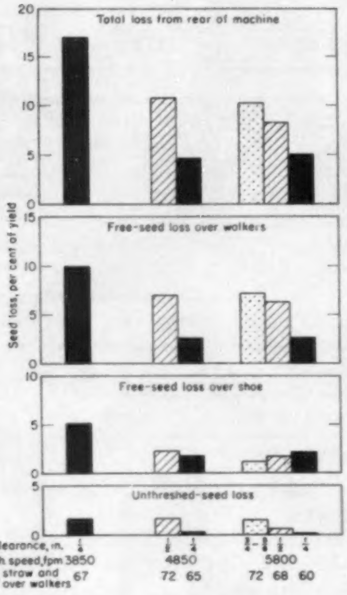
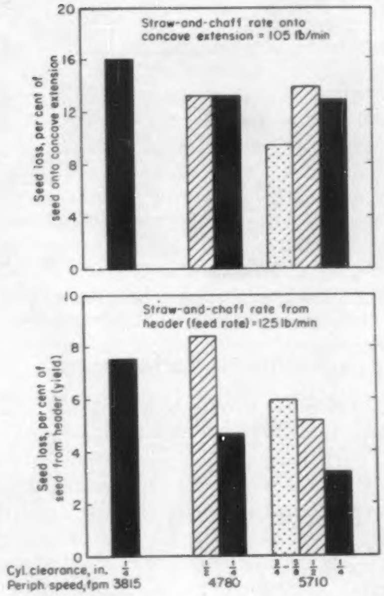



Fig. 4 *(Left)* Seed losses in relation to threshing effect for combine No. S-1 at feed rate of 125 lb per min (1955 tests)

Fig. 5 *(Right)* Walker free-seed loss in relation to threshing effect for combine No. S-1 (1956 tests)




cleaning area. However, as indicated in Table 1, the trailed machines had spike-tooth cylinders, cell-belt seed conveyors, raddle-type straw carriers, and seed recleaners, whereas the self-propelled machines had rasp-bar cylinders, straw walkers, and no recleaners. Presumably, some of the differences in types or arrangements of components must contribute to the greater capacity of the trailed machines when operating in barley.

### Effects of Cylinder Adjustments

In 1955, and again in 1956, machine S-1 was tested with six different combinations of cylinder-concave clearance and cylinder peripheral speed. For each combination, several runs were made at different feed rates. Fig. 4 and the lower graph in Fig. 5 show the effect of cylinder adjustment upon seed losses at a constant feed rate of 125 lb per min. Values for these bar graphs were taken from curves of seed loss versus feed rate.

Comparison of the three solid bars in each of the top two sections of Fig. 4 or in the lower part of Fig. 5, and comparison of all bars in any one speed group, indicates that increasing the threshing effect, by either increasing the cylinder speed or decreasing the clearance, caused a marked reduction in walker free-seed loss and in the total seed loss. The unthreshed-seed loss also decreased, as would be expected. The shoe free-seed loss was greatest at the lowest cylinder speed, perhaps because of less complete removal of beards. At the highest speed the shoe loss increased slightly as the clearance was reduced (Fig. 4), probably because of the smaller percentage of straw and chaff retained by the walkers and the resulting increase in shoe load (see data at bottom of Fig. 4).

After analyzing the 1955 data, two possible explanations were advanced for the observed but unexpected reduction in walker loss with increased threshing effect: *(a)* that the reduced loss was due to more complete bearding of the barley so that the seed separated from the straw more readily, and *(b)* that the increased threshing effect forced more seed through the concave grate so that the walkers had less seed to separate from the straw.

To test the second hypothesis, the combine was modified, prior to the 1956 season, by installing two removable pans and appropriate dividers (Figs. 6 and 7) to permit simultaneous collections of seed and chaff separated through *(a)* the concave-extension grate and front step of the walkers, and *(b)* the remaining four steps of the walkers. The 1956 test procedure then included the following steps, all performed in sequence without stopping or changing the forward speed of the machine:

*(a)* With the pans in their racks outside of the machine (Fig. 6), separate collections of the material from the walkers and from the shoe, as well as the seed from the grain spout, were made for a measured and timed distance in the usual manner.

*(b)* Immediately afterwards, the two pans were simul-

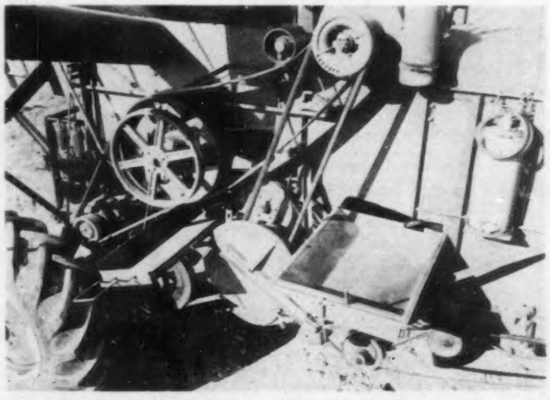


Fig. 6 Side view of combine No. S-1, showing the two pans that were added for the 1956 seed-separation studies. During normal operation the pans remain outside the body of the combine, as shown. For making collections, they are slid into the machine on angle-iron tracks

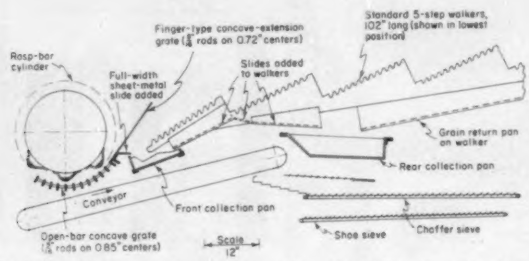



Fig. 7 Partial cross-sectional view of combine No. S-1, showing location of collection pans

## . . . Combine Performance

taneously slid into the body of the machine. After 10 sec of collection, they were quickly pulled out.

*(c)* After allowing an additional 50 ft of forward travel for normal seed flow to become re-established, the tailings were diverted and collected at the top of the return elevator for 10 sec, as described in reference 1.

The collections were then weighed and subjected to the usual procedure(1) for separating the free and unthreshed seed from each sample. The amount of material passing through the concave grate (open-bar type, as indicated in Fig. 7) was determined by subtraction.

In addition to confirming the 1955 results in regard to walker losses, the 1956 tests provided an explanation for these effects in terms of seed-flow patterns. Fig. 8 shows the seed-flow distribution pattern for one set of operating conditions. The percentages are based upon the seed from the header (seed yield) as 100 percent, and the widths of bands are in proportion to the percentages indicated. Note that at this feed rate the seed from the tailings (mostly free seed) increased the total seed load into the separating and cleaning units by 41 percent. In the 1955 tests even more seed was recirculated in the tailings. The percentage of seed from the tailings was essentially independent of cylinder adjustments and feed rate.

Under the conditions represented by Fig. 8, approximately 80 percent of the total seed into the cylinder (including tailings) was separated through the concave grate, leaving only 20 percent to go onto the concave extension and walkers. The results presented in Fig. 9 indicate that increasing the cylinder speed or decreasing the clearance (*i.e.*, increasing the threshing effect) forced more seed through

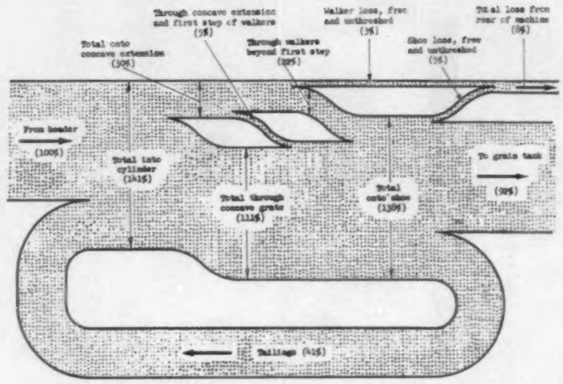



Fig. 8 Seed flow distribution through combine No. S-1 at a feed rate of 100 lb per min (1956 tests). Cylinder clearance = ¼ in. and peripheral speed = 4775 fpm

the concave grate, leaving a smaller percentage to be handled by the walkers.

If walker performance is considered on the basis of the amount of seed and amount of straw and chaff actually delivered onto the concave extension and walkers, as shown in the top graph of Fig. 5, the free-seed loss from the walkers was relatively independent of cylinder adjustment. Thus, the reduction in walker loss that resulted from the increased threshing effect was due primarily to the greater percentage of seed separated at the concave grate.

Fig. 9 also shows that, for a given cylinder adjustment, increasing the feed rate from 100 to 160 lb per min nearly doubled the percentage of seed that went onto the walkers. The actual seed rate onto the walkers was more than tripled by the 60 percent increase in feed rate. Presumably, the greater density of the blanket of material passing between the cylinder and concave at the higher feed rates inhibits seed separation through the concave grate.

The effects of cylinder adjustment upon the flow distribution pattern for straw and chaff are shown in Fig. 10. Increasing the threshing effect decreased the percentage of material carried over the walkers and increased the shoe load, primarily because of more material forced through the concave grate. There was little change in the percentage of material that passed through the openings of the concave extension and the walkers. This reduction in walker load with increased threshing effect was a minor factor contributing to the reduced walker free-seed loss. For any given

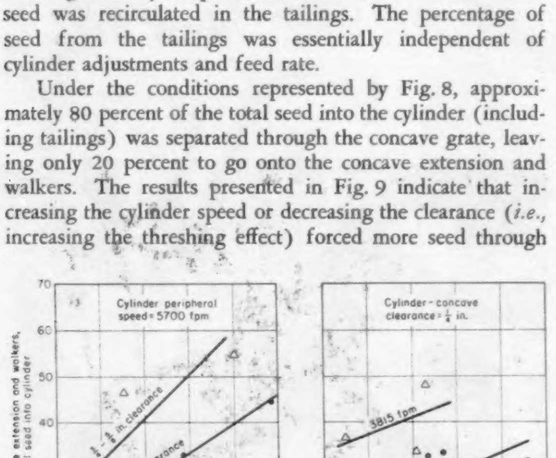



Fig. 9 Percentage of seed onto concave extension and walkers for combine No. S-1 (1956 tests)

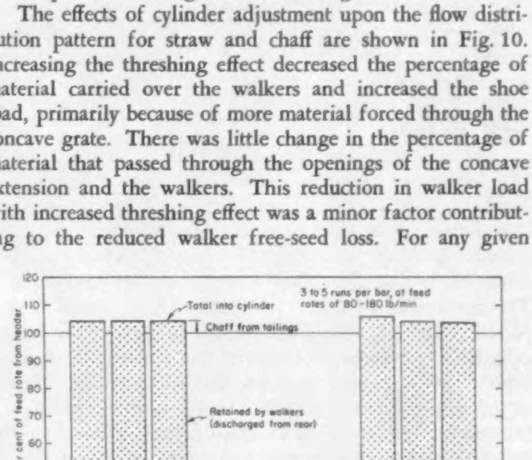



Fig. 10 Straw-and-chaff flow distribution for combine No. S-1 (1956 tests)

cylinder adjustment, the percentage of material carried over the walkers tended to increase somewhat as the feed rate was increased.

Maximum cylinder speeds and minimum clearances—desirable for minimum seed losses—are limited primarily by the amount of seed damage that is acceptable for the anticipated use of the barley. The malting trade, for example, demands a product with very little mechanical damage and with high germination. Seed barley should have a reasonably high germination, but considerable damage is acceptable in feed barley.

Results of seed-damage counts and germination trials for the 1955 tests are presented in Table 2. These data do

TABLE 2. EFFECT OF CYLINDER ADJUSTMENTS UPON SEED DAMAGE AND GERMINATION (1955 TESTS)

| Machine No. | Cylinder Type | Cylinder Speed, fpm | Cylinder Clearance | No. of samples | Percent visible damage* Skinned | Total | Percent normal germination |
|---|---|---|---|---|---|---|---|
| S-1 | rasp | 3800 | ¼ in. | 4 | 1.8 | 5.5 | 97.5 |
| | | 4850 | ½ in. | 3 | 1.7 | 10.1 | 94.0 |
| | | | ¼ in. | 32 | 2.1 | 11.4 | 92.8 |
| | | 5800 | ¾-⅜ in.† | 3 | 3.1 | 15.9 | 88.0 |
| | | | ½ in. | 3 | 7.7 | 22.4 | 85.9 |
| | | | ¼ in. | 3 | 2.0 | 11.7 | 92.2 |
| S-3 | rasp | 4900 | ⅞-5/16 in.† | 3 | 2.0 | 10.1 | 92.6 |
| T-3 | spike | 5575 | ½ up | 1 | 1.0 | 10.0 | 91.0 |
| T-4 | spike | 5750 | ¼-½ up | 3 | 3.0 | 14.0 | 90.3 |
| T-1 | spike | 6100 | ⅓ up | 3 | 3.0 | 19.0 | 87.0 |

*Skinned kernels had at least one-half the hull gone. Total visible damage includes broken, tipped, and skinned kernels.

†Clearances at front and rear of concave, respectively.

Seed moisture content—7 to 9 percent.

not indicate any consistent relation between seed damage and cylinder-concave clearance, within the range included in the tests. However, there was a definite increase in percent damage as the cylinder speed was increased. The total visible damage was about 10 percent at peripheral speeds of 4800 to 5000 fpm and 15 to 20 percent at 5800 to 6100 fpm. In general, the number of seeds that failed to germinate was about 4 percentage points less than the number of seeds with visible damage (skinned seeds and some of the tipped ones germinated satisfactorily).

The actual amount of seed damage for a given cylinder adjustment is influenced by the moisture content of the seed, the crop variety, and various other factors. Seed damage was considerably less in the 1956 tests than in the 1955 tests, even though the seed moisture content was about the same (7 to 9 percent). DeLong and Schwantes(2), in Minnesota tests with barley having 12 to 15 percent moisture, determined the effect of cylinder type and adjustment upon visible seed damage. Their damage percentages with a rasp-bar cylinder and ⅜ to ½-in. clearance were one-third to one-half as great as the 1955 values mentioned in the preceding paragraph. This difference is probably due mainly to the higher seed moisture content in the Minnesota tests.

The results of the tests at various cylinder adjustments indicate that, when harvesting barley, it is best to operate with a fairly close cylinder-concave clearance and with a peripheral speed as high as can be used without objectionable damage to the seed. Recommended values for the interior valleys of California and other warm, dry climates, are ¼ in. and 5000 to 5500 fpm.

The results also suggest that, under conditions where walker losses tend to be high and unthreshed losses are not a serious problem, it is important to obtain maximum seed separation through the concave grate, even at the expense of a moderate increase in the amount of straw and chaff forced through the grate and fed onto the shoe. Under difficult threshing conditions, however, it may be more advantageous to restrict or close the concave openings so that the heads or pods must pass over all of the concave bars (or past all the teeth). Some indication of the effect of operating with a closed concave can be obtained by comparing the 1955 results and those obtained in 1954 with a similar machine having the concave openings completely blanked off by means of sheet-metal covers. With a cylinder-concave clearance of ¼ in. and peripheral speeds of 4800 to 5100 fpm, the machine with the concave blanked off had more than twice as much free-seed loss over the walkers as did the open-grate machine in 1955.

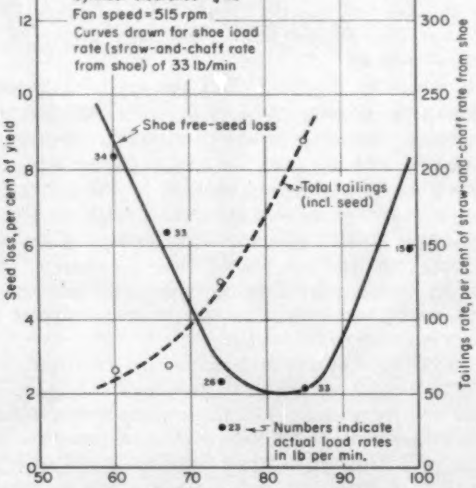



Fig. 11 Effect of fan opening upon shoe performance (1954 tests, riffle chaffer with finger-type extension)

## Effects of Cleaning-Shoe Adjustments

An adjustable-lip type of chaffer sieve was used in most of the 1955 and 1956 tests with machine S-1. With this chaffer, an opening of ½ to ⅝ in. appeared to give the best performance. The combine used in the 1954 tests (similar to No. S-1) was equipped with a riffle chaffer (non-adjustable)†.

Fig. 11 shows the effect of fan opening (or amount of wind) upon the shoe free-seed loss and the amount of tailings recirculated. Note that the free-seed loss increased rapidly when the air volume was either increased or decreased from the optimum range. Too little air results in insufficient agitation of the mixture on the chaffer sieve, whereas an excessive air blast tends to lift the seed and prevent it from falling through the chaffer openings. Changing the fan opening from 60 to 100 percent of the maximum increased the average no-load air velocity by only about 25 percent. Thus, it is evident that the air-volume adjustment for minimum shoe loss is fairly critical. It is important that this adjustment, whether made by changing the fan speed, adjusting shutters, or a combination of both, be easy and quick to change.

The broken-line curve in Fig. 11 indicates that the total tailings rate increased rapidly as the amount of wind was

†See reference 1 for descriptions of the types of chaffers.

increased. Free seed in the tailings represented 60 percent of the total tailings weight at the minimum fan opening and 90 percent at the full-open air adjustment. Unthreshed seed, which should ideally be the main constituent of tailings, represented less than 2 percent of the total. Presumably, the increase in amount of free seed in the tailings occurred because the higher air velocities interfered with the passage of seeds through the openings of the cleaning sieve.

The large amounts of recirculated free seed (30 to 40 percent of seed yield with optimum air adjustment in tests represented by Fig. 11) increase the seed load on the separating and cleaning units and thereby increase seed losses. The increase of shoe free-seed loss observed at the higher air rates was undoubtedly due in part to the greater amount of seed fed onto the shoe because of the increased tailings recirculation.

**Effects of Seed/Straw Ratio**

To determine the effect of seed/straw ratio upon machine performance (straw is used here to mean total straw and chaff), two comparative series of runs, one with a normal cut (long straw) and the other with a high cut, were made in 1956 with machine S-1. The average seed/straw ratios for the material delivered from the header were 1.07 and 1.70, respectively. In terms of the performance at the 1.07 seed/straw ratio (normal cut) and for comparable feed rates, the results for the 1.70 ratio (high cut) were as follows:

*(a)* The percentage of seed separated at the concave grate was about the same.

*(b)* The amount of straw and chaff carried over the walkers was only 80 percent as great (average of 56 percent retained versus 70 percent), resulting in a 45 to 50 percent increase in shoe load (probably a result of the greater proportion of chaffy material in the straw-and-chaff mixture from the high cut).

*(c)* The amount of seed in the tailings, expressed in percent of seed yield, was considerably greater.

*(d)* Shoe free-seed losses, in percent of seed yield, were three to four times as great, primarily because of the greater load of both seed and chaff (items *b* and *c*, above).

*(e)* Walker free-seed losses were about the same.

*(f)* The total loss from the rear of the machine, in percent of seed yield, was two to three times as great (at feed rates of 90 to 110 lb per min).

Thus, from the standpoint of feeding straw and chaff into the machine at a given rate, the increased amount of seed with the higher seed/straw ratio resulted in considerably greater percentage losses. However, if the comparison is considered to be for high and low cuts at a given forward speed or a constant total seed rate, the smaller feed rate with the high cut ($125 \times 1.07/1.70 = 78.5$ lb per min as compared with a corresponding rate of 125 lb per min for the low cut) resulted in a total loss that was about two-thirds as great as for the low cut. In other words, for a given maximum percentage seed loss the farmer can harvest more acres per hour when cutting high, but he cannot operate at as great a feed rate as when cutting low.

As another approach to determining the effect of seed/straw ratio, and as an indication of the effects of seed recirculated in the tailings, a series of runs at various feed rates was made in which the tailings were continuously diverted rather than being fed back into the cylinder. Diversion of the tailings reduced the average seed/straw ratio into the cylinder from 1.46 to 0.87. For a given feed rate and seed yield, the resulting shoe free-seed losses, in percent of yield, were only one-third as great as for normal operation with the tailings not diverted. The total seed loss from the rear of the machine was about two-thirds as great as normal. These results emphasize the desirability of minimizing the amount of seed recirculated in the tailings.

The results for both the high-cut tests and the tailings-diverted tests indicate that changes in the seed/straw ratio into the cylinder have a far greater effect on shoe losses than on walker losses. This relation is logical since, under normal operating conditions, seed/straw ratios for the material fed onto the shoe averaged about ten times as great as for the material fed onto the concave extension and walkers (4.2 versus 0.43 for ¼-in. cylinder clearance and 4850-fpm cylinder speed, in the 1956 tests). This effect of seed/straw ratio helps explain the fact that the shoe free-seed loss was considerably greater in 1956 than in 1955, since the average seed/straw ratios from the header were 1.07 and 0.60, respectively, for normal operating conditions in the two seasons.

**Summary**

1 High reel speed ratios can cause excessive header losses. For most conditions the reel peripheral speed should be 1.25 to 1.5 times the forward speed of the combine. A constant-ratio drive for the reel, in preference to the constant-speed drives usually provided, is highly desirable.

2 With the 12-ft self-propelled combines tested in these studies, seed losses became excessive when feed rates (straw and chaff input) exceeded 100 to 125 lb per min.

3 Several large, trailed combines with raddle-type straw carriers and built-in seed recleaners were tested and found to have 2 to 2½ times as much straw-and-chaff capacity as the self-propelled machines (for a reasonable total seed loss of 2 to 4 percent in each case). The trailed combines had only 35 percent more separating area and 85 percent more cleaning area than the self-propelled combines. Other differences must account for a considerable portion of the increased capacity.

4 When the threshing effect was increased by either increasing the cylinder speed or decreasing the clearance, there was a substantial reduction in walker free-seed loss and in total seed loss from the rear of the machine. The reduction in walker loss was found to be due primarily to a greater percentage of seed separated through the concave grate, which resulted in a smaller percentage of the total seed input being fed onto the walkers.

5 For any combination of cylinder adjustments included in the tests, the percentage of seed fed onto the walkers increased with feed rate.

6 Under the warm, dry conditions of these tests, only 65 to 75 percent of the total straw-and-chaff input was carried over the walkers, the balance going onto the cleaning shoe. Increasing the threshing effect decreased the percentage of material carried over the walkers, primarily because of more straw and chaff forced through the concave grate. This slight reduction of walker load was a minor factor contributing to the reduced walker free-seed loss mentioned in item 4. *(Continued on page 711)*

**_Erosibility of intense storms may be determined with acceptable degree of accuracy by studying easily measured rainfall characteristics_**

# How Intense Rainfall Affects Runoff and Soil Erosion

**Aurelius P. Barnett**
*Member ASAE*

SCANT reference is made in the literature reviewed to studies of the characteristics of individual intense storms and their relation to runoff and erosion. Numerous investigators have treated runoff and erosion in relation to rainfall on a seasonal and annual basis. This type of work clearly shows that the period of the year, during which the principal erosion hazard exists, to be the warmer months in the United States, but does not treat the individual intense storm in such a way as to enable proper evaluation of such storms. At present, a workable method does not exist for predicting, from rainfall data alone, the erosion damage to be expected from a single storm or group of storms.

If the erosion damage to be expected from a given storm could be evaluated through the use of rainfall data, the potential hazards to a given geographic area could be estimated through the use of U. S. Weather Bureau records and local soil classification data. Runoff and soil erosion data already compiled could be made applicable to larger regions through correlation with rainfall and soils data.

The study described herein was undertaken to determine the relationships which exist between individual intense storms, runoff, and soil erosion, and had as its objective the development of a method by which a single or combination of easily measured rainfall characteristics might be used to express, with an acceptable degree of accuracy, the erosivity of intense storms.

## Review of Literature

Intense storms are of high kinetic energy. An intense or excessive rate storm is defined by Yarnell(24)† as one whose precipitation in inches in a given time equals or exceeds the time in minutes divided by one hundred; plus 0.20. It contains a greater percentage of larger raindrops than one of moderate to low intensity and is the principal source of energy in the soil erosion process. Ellison(10, 11, 12, 13) has shown that the impact of raindrops upon the soil surface starts the erosion process by dislodging individual soil particles, which are subsequently washed away or moved to new locations down-slope by overland flow.

Unpublished data at Watkinsville, Ga., shows that intense storms caused 83 percent of the annual erosion from experimental plots planted continuously in cotton during the 13-year period, 1940-52. Similar research data throughout the country substantiate the fact that intense storms are a principal cause of erosion on sloping agricultural lands. Such storms are usually associated with thunderstorm activity. Thunderstorms are generally characterized by high winds, excessive rainfall intensities, and short duration as described by Brancato(5). The incidence of thunderstorms is much greater during the warmer months of the year and their occurrence coincides with the growing season of most agricultural row crops.

In the literature reviewed only three references were found in which storm characteristics were considered in relation to erosion on an individual storm basis.

Hays *et al*(6) developed correlation coefficients for runoff, soil erosion, total rainfall, and the maximum 5 and 30-min rainfall intensities. A very satisfactory correlation with runoff and erosion was obtained by the use of these factors. However, neither were standard errors reported, nor was there a clear definition of what were called high, medium, and low factor storms.

Foster(5) treated nine indices of rainfall intensity statistically and concluded that the 15-min maximum intensity was a better index of intensity than the 5-min maximum intensity, while the 15-min maximum intensity was surpassed by a combination of the 5 and 15-min maximum intensities at a significance level near 8 percent. The best single index of intensity was the 30-min rate. He did not study a 60-min maximum intensity.

Smith *et al*(2) studied the relationship of the 5, 15, and 30-min maximum rainfall intensities and antecedent soil moisture in relation to the maximum rate of runoff from 79 storms with a 15-min maximum intensity of one inch per hour or more over an eight-year period. Runoff was from an 8.03-acre watershed of 6.7 percent slope in uphill and downhill culture. A highly significant multiple correlation coefficient $(r)$ of 0.73 was obtained with a standard error of plus or minus 0.66.

The estimating equation obtained was

$$X_1 = -1.11 + .29X_2 - .15X_3 + .85X_4 + .73X_5$$

in which $X_1$ = maximum rate of runoff in inches per hour
$X_2$ = 5-min rainfall intensity in inches per hour

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Paper and summary presented at the Winter Meeting of the American Society of Agricultural Engineers at Chicago, Ill., December 1954 and December 1956, on a program arranged by the Soil and Water Division.

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†Numbers in parentheses refer to the appended references.

$X_3$ = 15-min rainfall intensity in inches per hour

$X_4$ = 30-min rainfall intensity in inches per hour

$X_5$ = antecedent rainfall index.

The antecedent rainfall index as an expression of soil moisture was numerically equal to the sum of the previous twenty days daily rainfall amounts, after each was divided by the number of days the rain preceded the storm in question. He found that the 30-min rainfall intensity had the greatest effect on the maximum rate of runoff.

Copley *et al*(7) states that soil losses are not directly proportionate to the total amount of rainfall each month, but are more closely associated with rainfall intensity.

Borst *et al*(4) indicated that the increased intensity of summer rainfall rather than a greater amount of rainfall was responsible for higher erosion losses during the summer growing season.

Daniel *et al*(8) found that little relation existed between total rainfall and total amount of runoff. He also found that duration of rainfall had little effect on amount of runoff. He showed that under uniform soil-moisture conditions rainfall intensity was the most important rainfall factor causing runoff. Neal(20) found rainfall intensity to be the most important factor affecting runoff and erosion from data obtained from the use of artificial rainfall on variable slope plots in a greenhouse.

Pope *et al*(21) studying soil losses on relatively bare Kirvin fine sandy loam concluded that high erosion losses did not necessarily result from large amounts of rainfall alone, but that variation in rainfall intensity throughout the year could be considered as a more direct indicator of probable erosion than any other characteristic of rainfall. He also pointed out that the major soil losses during a year resulted from a few high intensity storms that occurred most frequently during the warmer months of the year but that such storms could occur during any month.

Baver(2) found that the amount and intensity of rainfall and the effective soil moisture condition were closely related to erosion. He also considered the distribution of storms in relation to the amount of protection afforded by crops to be important.

Laws(18, 19) concluded from his work with raindrops, waterdrops, and erosion that amount and duration of a storm did not adequately describe a rain. Knowledge of the size and velocity of the raindrops was needed to properly characterize a rainstorm.

Borst *et al*(4) studied ninety storms which caused one-tenth ton per acre of erosion or more from a bare plot during a four-year period. He concluded that rains which caused one ton per acre or less of erosion were relatively unimportant as they accounted for only about six percent of the four-year erosion. He stated that probably the most important storms were those which caused five tons per acre of erosion or more, as they accounted for about three-fourths of the four-year erosion. There was an average of about six such storms per year.

## Background

The data reported here were taken from runoff and soil erosion research conducted at the Southern Piedmont Conservation Experiment Station, Watkinsville, Georgia. The purpose of this work was to test the erosion control value of different crops and crop rotations on lands of different slope, and was begun in 1938. These data cover the period 1940-52.

TABLE 1. ANNUAL RAINFALL, RUNOFF, EROSION, AND NUMBER OF EXCESSIVE RATE STORMS AND THE PERCENT OF ANNUAL RAINFALL, RUNOFF, AND EROSION ASSOCIATED WITH EXCESSIVE RATE STORMS AS MEASURED ON CLASS III LAND CONTINUOUS COTTON PLOTS AT WATKINSVILLE, GEORGIA

| | Annual totals | | | | Percent associated with excessive rate storms | | |
|---|---|---|---|---|---|---|---|
| Year | Rainfall, inches | Runoff, inches | Erosion, tons per acre | Excessive rate storms, number | Rainfall | Runoff | Erosion |
| | | | | | Percent of annual | | |
| 1940 | 49.8 | 8.0 | 12.0 | 8 | 31.1 | 72.5 | 80.8 |
| 1941 | 37.9 | 5.6 | 16.7 | 13 | 42.7 | 76.8 | 94.0 |
| 1942 | 54.6 | 14.8 | 35.8 | 16 | 52.2 | 66.9 | 86.9 |
| 1943 | 56.7 | 16.9 | 51.9 | 16 | 39.8 | 66.3 | 84.4 |
| 1944 | 53.1 | 12.8 | 27.8 | 13 | 23.9 | 38.3 | 79.5 |
| 1945 | 44.9 | 7.8 | 17.6 | 7 | 37.6 | 75.6 | 89.2 |
| 1946 | 58.5 | 10.7 | 26.4 | 15 | 38.3 | 70.1 | 94.7 |
| 1947 | 52.5 | 10.1 | 11.6 | 9 | 15.8 | 25.7 | 69.3 |
| 1948 | 65.0 | 19.2 | 20.8 | 8 | 17.2 | 24.5 | 60.6 |
| 1949 | 50.7 | 9.9 | 8.2 | 13 | 24.4 | 52.5 | 67.1 |
| 1950 | 39.2 | 6.8 | 5.2 | 9 | 33.2 | 69.1 | 69.2 |
| 1951 | 39.9 | 6.4 | 11.4 | 11 | 33.3 | 65.6 | 96.5 |
| 1952 | 44.6 | 9.3 | 8.7 | 9 | 27.6 | 64.5 | 87.4 |
| 13 yr. average | 49.8 | 10.6 | 19.5 | 11.3 | 31.7 | 55.7 | 83.6 |

Correlation analysis

| Factors | $r$ |
|---|---|
| Rainfall and runoff | 0.882** |
| Rainfall and number of excessive rate storms | 0.213 NS |
| Rainfall and erosion | 0.549 NS |
| Runoff and number of excessive rate storms | 0.315 NS |
| Runoff and erosion | 0.691* |
| Excessive rate storms and erosion | 0.696* |

$n = 13$ *$r$, 5 percent = 0.553 **$r$, 1 percent = 0.684

NS = not significant

Data on runoff and erosion were obtained from runoff plots planted continuously in cotton located on Class IIIe Land Cecil sandy clay loam of seven percent slope. The plots were 20.74 ft wide and 70 ft in length. A description of plot layouts and measurement techniques are described by Carreker and Barnett(6).

Annual rainfall, runoff, and erosion varied widely during the 13-year period 1940-52. Table 1 gives a summary of these data.

Though rainfall, runoff, and erosion varied widely from year to year, a simple correlation analysis between annual rainfall, runoff, number of excessive rate storms, and erosion for the 13-year period 1940-52 indicated that amount of rainfall and runoff, runoff and erosion, and number of excessive rate storms and erosion are closely related. No significant relationship was found between rainfall and number of excessive storms, rainfall and erosion, or runoff and number of excessive storms.

The seasonal distribution of excessive storms, rainfall, runoff, and erosion given in Table 2 show a close relationship between excessive storms and the amount of erosion. Excessive storms accounted for one-third of the rainfall, over half of the runoff, and four-fifths of the erosion.

## Procedure

Methods of multiple correlation analysis were used to determine the degree of relationship between different storm characteristics and erosion. Statistical procedures described by Snedecor(23) and Ezekiel(14) were followed.

TABLE 2. AVERAGE SEASONAL RAINFALL, NUMBER OF EXCESSIVE RATE STORMS, RUNOFF, AND EROSION FROM CLASS III LAND CONTINUOUS COTTON FOR THE 13-YEAR PERIOD, 1940-52

| Season | Rainfall, percent | Excessive storms, number | Runoff, percent | Erosion, percent |
|---|---|---|---|---|
| WINTER (Dec-Feb) | 28.2 | 0.7 | 26.1 | 16.7 |
| SPRING (Mar-May) | 28.2 | 2.5 | 25.1 | 26.7 |
| SUMMER (June-Aug) | 25.3 | 6.4 | 28.5 | 49.9 |
| FALL (Sept-Nov) | 18.3 | 1.7 | 20.3 | 6.7 |
| ANNUAL | 100.0<br>49.81 in. | 11.3 | 100.0<br>10.64 in. | 100.0<br>19.55 tons per acre |

Since a simple expression of the relationship between rainfall and erosion was desired, only those rainfall characteristics which could be taken directly from recording raingage charts were considered, except runoff, which was included to complete the coverage of factors. Specific characteristics and factors studied were

1 Time of occurrence (month of the year)
2 Duration of the storm in hours
3 Amount of rainfall in inches
4 Maximum rainfall intensities in inches per hour for 5, 15, 30, and 60 min
5 An index of antecedent soil moisture based on antecedent rainfall
6 Runoff in inches
7 Soil erosion in tons per acre.

The factor of time of occurrence was selected in order to establish whether or not the period of the year during which a storm occurred had any bearing on the amount of erosion produced under continuous cotton culture. This index would give an indication of whether such factors as land preparation, planting, cultivation, plant growth, and untilled cotton stalk land during fall and winter had definite relationship to the amount of erosion produced by intense storms.

Time of occurrence for the 98 storms studied was coded on the basis of the percentage of the 1940-52 thirteen-year average annual erosion which occurred during the different months. Storms which occurred in the different months were coded as follows:

| Month | Code | Month | Code |
|---|---|---|---|
| December | 1.7 | June | 15.7 |
| January | 8.3 | July | 23.1 |
| February | 7.0 | August | 10.9 |
| March | 8.2 | September | 3.6 |
| April | 11.2 | October | 1.3 |
| May | 6.9 | November | 2.1 |

Since maximum intensities are widely used in runoff and erosion studies as an index of severity, maximum rainfall intensities of 5, 10, 15, 30, and 60-min for each storm were included as factors in this study.

Antecedent rainfall as an index of antecedent soil moisture was determined as the total rainfall for 5 and 20-days prior to the storm in question.

## Results

Correlation coefficients *(r)* for different factors and combinations of factors and erosion are given in Table 3. All combinations of factors were significant. Significance is to be expected in correlations using a large number of observations, so mere significance in this study is of little value. Of the eight single factors considered, the maximum 60-min rainfall intensity had the highest correlation coefficient *(r)* of 0.769**. On that basis the maximum 60-min rainfall intensity would be the single factor of those considered which would bear the closest relationship to erosion. The linear regression equation shown in Fig. 1 for the 60-min intensity and erosion was

$$E=3.33X-0.73$$

when $E$=estimated erosion in tons per acre per storm, $X$= 60-min maximum rainfall intensity, and $-0.73$ and 3.33 are constants.

The standard error of estimate was 1.46 tons per acre per storm, and $r$, the correlation coefficient, was 0.769**. The equation accounts for 59.1 percent of the erosion sum of squares.

The average erosion per storm for the 98 storms was 2.13 tons per acre, with an average maximum 60-min rainfall intensity of 0.86 in. per hr. If the standard error of the erosion mean plus or minus 0.10 is considered, there would be a range of 2.03 to 2.23 tons per acre per storm within which the true mean for these 98 storms would lie. On the assumption that these data represent a valid sample of intense storm populations, similar data could be expected to produce accurate results within about five percent.

For the purpose of estimating the erosion to be expected from selected individual storms, the standard error would be the erosion mean of 2.13 tons per acre plus or minus 1.46 tons per acre. This gives a range of 0.67 to 3.59 tons per acre for individual estimates near the mean. The range grows much greater as the 60-min rainfall intensity de-

**Highly significant.

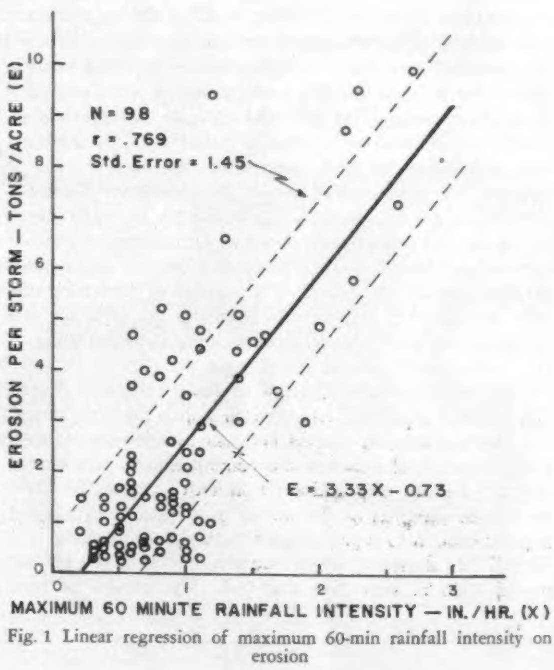


Fig. 1 Linear regression of maximum 60-min rainfall intensity on erosion

## . . . Intense Rainfall

TABLE 3. SUMMARY OF STATISTICS FOR THE REGRESSION OF EROSION ON TWELVE COMBINATIONS OF FACTORS

| Factors n=98 | Sum of squares accounted for by regression | Percent of erosion sum of squares | Correlation coefficients | Standard errors of estimate |
|---|---|---|---|---|
| 1 Time of occurrence of storms | — | — | 0.241 | — |
| 2 Rainfall amount | 134.6 | 27.3 | 0.522 | 1.93 |
| 3 Maximum 5-min rainfall intensity | 152.6 | 30.9 | 0.556 | 1.88 |
| 4 Maximum 10-min rainfall intensity | 185.2 | 37.5 | 0.612 | 1.79 |
| 5 Maximum 15 min rainfall intensity | 208.4 | 42.2 | 0.650 | 1.72 |
| 6 Runoff amount | 226.4 | 45.9 | 0.678 | 1.67 |
| 7 Maximum 30-min rainfall intensity | 280.0 | 56.7 | 0.753 | 1.49 |
| 8 Maximum 60-min rainfall intensity | 291.8 | 59.1 | 0.769 | 1.45 |
| 9 Rainfall amount and 60-min intensity | 301.2 | 61.0 | 0.781 | 1.42 |
| 10 Rainfall amount, plus max. 5, 10, 15, 30, and 60-min intensities plus time of occurrence | 314.2 | 63.7 | 0.798 | 1.41 |
| 11 Rainfall amount plus 30-min and 60 min intensity | 309.7 | 62.8 | 0.792 | 1.39 |
| 12 Maximum 60-min intensity and runoff | 326.9 | 66.2 | 0.814 | 1.32 |

$r$, 5 percent=0.197 for item 1; $r$, 1 percent=0.257 for items 2-12.

parted from the mean intensity of 0.86 in. per hour. Therefore, the 60-min intensity alone will not give a satisfactory estimate of expected erosion from individual storms. Probably an acceptable range would be about ten percent of the mean.

Because of this wide range, each of the eight factors was studied separately, all combined, and certain selected combinations were tried as estimators of expected erosion. When the 60-min intensity and the runoff were used in a multiple regression, the standard error of estimate was reduced to 1.32 with an $r$ value of 0.814**. This combination accounted for 66.2 percent of the erosion sum of squares, but since runoff cannot be considered a rainfall characteristic such a combination would not be applicable to this study. All other combinations of factors studied resulted in $r$ values between the one obtained from the single factor 60-min intensity and runoff. For purpose of estimating erosion, the different factors considered did not offer any real improvement over the 60-min rainfall intensity alone in the estimating of erosion from single storms.

The storms which occurred in June, July, and August were studied separately from the 98 storms previously used. Correlations were developed between the 60-min intensity and erosion, and between the combination of amount of rain, 60-min intensity, and duration with erosion. The introduction of duration of the storms gave some improvement but not enough to change the relationships appreciably.

All 287 storms which caused runoff during the 12-year period 1940-51 were then analyzed. The amount of rainfall, the 60-min intensity, and a combination of the two were correlated with erosion. Amount and 60-min intensity together gave a standard error of estimate of 1.00. This indicated that the inclusion of all storms during the period might be advantageous, but this error is still too large for estimating expected erosion for single storms. A summary of these correlations is given in Table 4.

The preceding correlations showed clearly that the factors tested could not by themselves or in combination with each other provide an adequate estimator for expected erosion from single storms.

As a refinement in the above procedure, only single excessive rate storms were selected, and several additional factors were included in the analysis. A single excessive storm was one which met Yarnell's classification for excessive storms and occurred alone without any other storm included in the runoff and erosion recorded. The 5 and 20-day antecedent rainfall and the duration of each storm was included in the analysis. Where only single excessive storms were concerned, the correlation between time of occurrence and erosion and duration of the individual storm and erosion were not significant. In the 48 summer storm periods previously mentioned, duration seemed to contribute to the improved accuracy of the estimates. Runoff had the highest correlation with erosion, next highest with the 15-min intensity, and third highest with the 60-min intensity. The different correlations showed that the method of selection of storms for study had a marked influence on the results obtained.

A multiple regression of rainfall amount, the 20-day antecedent rainfall and the 15 and 60-min maximum rainfall intensity on erosion was developed from the 54 single storms. The equation was

$$E=0.7668+1.0539X_2+0.1914X_5-0.0101X_7 +5.7692X_9$$

in which $X_2$=rainfall amount

$X_5$=rainfall in preceding 20 days

$X_7$=15-min rainfall intensity

$X_9$=60-min rainfall intensity

The standard error of estimate was 1.18 and $r$ was 0.799.** The equation accounted for 63.8 percent of the erosion sum of squares. This combination of factors gave slightly better results than did the use of the equation for 60-min intensity

TABLE 4. SUMMARY OF MULTIPLE REGRESSIONS ON EROSION, BASED ON 48 SUMMER STORMS AND 287 RUN-OFF PRODUCING STORMS FOR THE 12-YEAR PERIOD, 1940-51

| Factors | Regular sum of squares | Percent of error, sum of squares | Correction coefficient | Standard error of estimate |
|---|---|---|---|---|
| *48 summer storms* | | | | |
| Maximum 60-min intensity | 148.0 | 66.6 | 0.816** | 1.27 |
| Rainfall amount 60-min intensity and duration | 156.8 | 70.6 | 0.840** | 1.20 |
| *287 runoff producing storms* | | | | |
| Rainfall amount | 183.1 | 23.1 | 0.481** | 1.46 |
| Max. 60-min intensity | 495.1 | 62.5 | 0.790** | 1.04 |
| Rainfall amount and 60-min intensity | 505.8 | 63.8 | 0.799** | 1.00 |

**Highly significant.

**Highly significant.

alone, but its complexity does not warrant its recommendation over the simpler 60-min intensity equation.

**Discussion of Results**

The erosion to be expected from an individual storm *cannot* be predicted with a satisfactory degree of accuracy through the use of the rainfall characteristics used in this study, when analyzed by correlation and multiple correlation analysis. This can be attributed in part to the fact that the classification of storms by maximum intensities disregards all peak rates except the maximum one for each time interval considered. In reality a storm might contain several periods of high rainfall which materially influences its erosion-producing ability. The method outlined by Foster(5) in his study of indices of rainfall intensity, in which he accounted for the presence of more than one period of high intensity, might aid in improving the capabilities of estimating expected erosion through the use of rainfall characteristics.

It was noted that the 5-min rainfall intensity was the least descriptive of expected erosion of the rainfall intensities studied while the 60-min rainfall intensity was the most descriptive. This can be explained in part by the fact that high-intensity rainfall of short duration does not as a rule satisfy the surface storage and retention requirements of a plot. The shorter time interval intensities are over before surface flow can reach the trough from a major portion of the plot. As the intensity time interval increased and approached the duration of the storm, the degree of correlation with erosion increased. The amount of rainfall did not bear significant relationship to erosion. This showed that volume of rainfall alone was not an important factor in the erosion process even though runoff, the product of rainfall, was significantly related to amount of rainfall. Runoff in relation to erosion was highly significant. This points further to the fact that some aspect of rainfall characteristics has been overlooked in this analysis. A rainfall characteristic which might improve the accuracy of estimating erosion by this method would be the inclusion of the number of periods of peak rainfall intensities in a storm rather than just the maximum intensity alone. This is in support of the work of Laws(7, 8) who concluded that amount and duration were not satisfactory factors for describing a storm.

When the 60-min rainfall intensity equation for estimating erosion, $E=3.33X-0.73$, was applied to all storm data (287 storms) for the 12-year period, 1940-51, it was shown that this equation was completely unsatisfactory for estimating erosion on an annual long-time basis since the estimated average annual erosion was 43.8 percent above that which was actually recorded.

When only summer storms were studied, neither was a useful improvement made in the degree of correlation of the maximum 60-min intensity with erosion nor the correlation of both the 60-min intensity and rainfall amount with erosion as compared with the data developed from the original 98 storms. Similar results were obtained when all runoff-producing storms during the 12-year period were studied, 287 in all.

Like results were obtained when only the 54 single storms were selected from the original 98 storms, and additional factors of duration and the 20-day antecedent rainfall were introduced. The multiple-regression equation of rainfall amount, the 15 and 60-min rainfall intensities and the 20-day antecedent rainfall on erosion, gave an improved multiple correlation coefficient of 0.799 which was only 0.30 better than that for the 60-min rainfall intensity alone. This shows that the additional factors studied did not improve the estimating ability of the equation appreciably.

Even though no satisfactory equation for predicting expected erosion was developed from the data studied, it is felt that a more thorough study of this subject might yield a practical equation for estimating expected erosion. A possible approach would be the use of factors other than maximum intensities which would give a more complete picture of a storm.

**Summary**

Easily measured rainfall characteristics were correlated with erosion from 98 selected intense storms in an effort to derive a usable mathematical relationship that would express with an acceptable degree of accuracy the expected erosivity of individual intense storms.

Factors studied in relation to erosion were rainfall; amount, duration, maximum 5, 10, 15, 30, and 60-min intensities, and time of occurrence, runoff, and antecedent soil moisture.

No single rainfall characteristic or combination of characteristics of those studied was found which would serve to adequately predict the expected erosion from a given storm for the conditions studied.

The maximum 60-min rainfall intensity was found to be the single factor most closely related to erosion. The linear regression equation for erosion and 60-min intensity was $E=3.33X-0.73$. The standard error of estimate was quite large, being 1.46 tons per acre, and the correlation coefficient *(r)* was 0.769**.

When the 60-min intensity equation was applied to all runoff producing storms over the 12-year period, 1940-51, the average annual estimated erosion was 44 percent above the actual average. The average annual erosion measured was 20.46 tons per acre, while the amount estimated by the formula, $E=3.33X-0.73$, was 29.34 tons per acre.

Multiple regression equations involving selected combinations of the other factors studied did not result in a prediction equation superior to the 60-min intensity alone.

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*(Continued on page 711)*

**Highly significant.

# Engineering, Management and Marketing Combined for Successful Farming

W. H. Yaw
Affiliate ASAE

***Support is given to advancement of pre-engineered farm building systems into rural-processing or in-the-area development of small businesses—based on free enterprise***

THIS is precisely what industry has been doing for years to maximize their profits. Currently, the subject is getting praise and condemnation in agriculture under the term "Integration." It has come as the shift in emphasis and interest in agriculture turns from production to marketing problems.

Agriculture faces the stern necessity of developing a coordinated control marketing system which specifies quantities of quality products more evenly available throughout the year. This in contrast to the pattern of the industry in the past to produce and then look for its market.

Commercial agriculture defined here includes the 42 percent of the nation's farms which produces 86 percent of our food and fiber according to 1955 released figures. It is in the hands of this segment of agriculture that the real possibilities lie for its product and service improvement. It is imperative to the freedom and welfare of agriculture that we utilize every resource at our command to insure that agriculture redevelop a position which is on a balance with industry and labor.

1955 BREAKDOWN OF U. S. FARMS

| No. Farms | Percent total number | Percent total production |
|---|---|---|
| 1,000,000 | 20 (full time) | 8 |
| 1,700,000 | 38 (part time) | 6 |
| 2,000,000 | 40 | 60 |
| 100,000 | 2 | 26 |

The "Agricultural Problem" is in reality two large sets of problems with overtones of a third. The first set of problems are more sociological than economic in nature. They are those facing "non commercial" farm people and farmers just on the margin. The second includes the variety of inter-related problems confronting "commercial" agriculture in attempting to adjust to the rapidly changing technological and economic conditions involved in production and marketing.

There is a third set of problems comprising that complex mixture of economic, sociological and political problems confronting rural, non-farm people whose lives are so dependent on their farm neighbors. It is the second set of problems with which this paper is primarily concerned. However, considerable concern will spill over into the third set of problems because the two are inter-related.

The American genius for rapidly advancing technology in agriculture has developed a real difficulty in the under utilization of human resources. This is affiliated not only with the farm, but spills over into the myriad of small towns surrounding agriculture. At present, this overspill is being accentuated by our drive to consolidate farms into bigger units (frequently mistaken for efficiency). These areas comprise, it probably would be safe to say, 33 to 40 percent of the people of the United States. I call these the people who are "cut off." I might add a good deal of our industrial markets have been found in these areas in the past.

U. S. URBAN AND RURAL GROUPS
1950 CENSUS

| | | | |
|---|---|---|---|
| Total population | | | 146,619,592 |
| Farms | | 4,800,000 | |
| Rural territory ½ of 53,964,053 | | 26,982,026 | |
| Urban territory | | | |
| 5000 - 10,000 | 8,123,192 | | |
| 2500 - 5,000 | 6,481,676 | | |
| All other | 7,898,892 | | |
| | | 22,503,780 | |
| 36 to 40 percent total | | 54,286,786 | |

The small townspeople and farmers frequently are at cross purposes with one another, thus further tending to retard the rate at which human resources are being developed or encouraged to raise our overall standard of living. In the face of this situation, the farmer is plagued with the dilemma of a serious sustained cost-price squeeze. Briefly, he is losing out in the market place as the food chains, producers of secondary feed, packers and processors push on one another for profit margins.

We have been waiting for big industry to come into these small rural areas. I am beginning to believe that this industry will not decentralize quickly enough to supplement explosive technology which is replacing agricultural workers. Also, small towns who have survived without industry are not going to make adjustments quickly enough to be of assistance. It is also time we realize that moving people out of their own environment accelerates our problems rather than creates solutions in themselves.

I have long felt that decentralization of American Industry is a big plank in a sound development program as our country matures. It has in it many promising seeds of orderly development for both city people and farm people.

Certainly we should continue to work in areas of efficiency while struggling with farm policy and this human resource problem. It seems to me we might have an opportunity to solve the human resource problem and continue working on efficiency by more fully realizing the creative talents of the agricultural engineer in expanding farm process engineering.

This is an area which has been on the fringe of attention

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by both engineers and economists for about ten years. Engineers have looked on it as materials handling and work elimination. Economists have referred to it as work simplification and other terms. It is a field that deserves major attention as pressure for quality standards over time in our food industries intensifies.

Up to now the studies have been made on farms as single units or on factories as units. But interest is stepping up to consider groups of farms and the small towns surrounding agriculture together in area development. Thus as the farms grow in size and there are fewer retail customers in a given rural area, the shrinking retail market can be supplemented with a farm processing market which can furnish more goods and services for consumption both ways—on the farm and off.

It is evident that just as the farmer has educated many of his sons through the land-grant system, subsidizing both industry and more recently increasing portions of agricultural industry; that he with the help of his rural townspeople must now turn to creating industry in his own areas. It is essential that commercial agriculture be alert to changes before they occur to insure modification to maintain equity and freedom on a par with industry and labor. It is essential that research inputs in agriculture be expanded to provide for such activity. We cannot be content to continue to watch how non-farm industry adapts itself and copy their methods. Things are changing so fast today that before we can copy industry's methods, middlemen outside agriculture will have control of its position.

Commercial agriculture can remain relatively free only if it accepts the responsibility for marketing as well as production of its products. There are essentially three types of complementary adjustments:

*(a)* Farmers and those closely affiliated must accelerate coordinated production planning on the basis of market demands. (This area is open for much research.)

*(b)* There must be closer coordination of the whole process of production and marketing.

*(c)* There must be accelerated development of similar coordination of farm supply products with operating requirements of commercial farms.

All three types of development involve in some form or another the extension of functions usually considered as marketing.

These complementary adjustments have been slowly taking form and shape among farm cooperatives and individual Farm Bureau units for many years. The most efficient of these units can survive.

I believe, however, that industrialization of agriculture can be done by fewer people than we realize. Also I believe we in agriculture have a great deal to gain by pure capitalistic or corporate establishment of entity units.

These units to be successful will have to continue to utilize changing technology to lower production costs, reduce transportation, and utilize as much of their by-products as possible. They will have to move into the marketing functions factor and coordinate it with production.

In addition, every effort must be made to supply markets away. Agricultural products must constantly be refashioned for possible industrial utilization. This will provide some outlet for excess capacity and permit a continued positive orderly use of technology.

However, we in agriculture must condition our minds in a positive fashion toward providing research and setting the stage for industrial utilization of farm products. This is the fourth type of adjustment which should be accelerated.

We are all aware of the major changes taking place in such industries as broilers and citrus in recent years. These industries in some instances have completely shifted geographically. They will, however, return to their original areas as demand increases.

It is time all of agriculture frankly recognized the trend toward refined coordination of production, marketing and farm supply operations. Moreover, it is time that farmers take the lead in developing these functions. This leads me to coin three phrases and some examples which might be useful. They are the Economy Industry, the Partial Economy Industry, and the Partial Economy Industry Package.

### The Economy Industry

An economy industry is one which substantially reduces the capital and labor requirements for production and distribution of an essential commodity. When an essential commodity has been in use for some length of time, a newcomer in the industry, or a stabilized company desiring to forge ahead frequently comes along to enter the field with a more efficient process.

An example in agriculture might be the liquid fertilizer industry which expanded from 40,000 tons in 1946 to around 200,000 tons in 1957—only about 1.4 percent of the total fertilizer industry but certainly a promising prospect for the future. I might add that the majority of this expansion has taken place in the north central region and in California, our major food and fiber production areas.

Another example is a group of highly specialized egg farmers, averaging 5000 or more layers per farm who organize their own cooperative or corporation. They establish rigid standards of quality, assemble, grade, carton and distribute their eggs directly to chain stores or other outlets in nearby or distant cities. All possible middlemen are eliminated in the process. Volume, quality and services are closely coordinated with market demands.

This economy industry whenever developed must be a forward industry, one which either uses a new process or develops a new product which is highly efficient.

### The Partial Economy Industry

This is a highly efficient process which can run seasonally or for limited periods during the year. Alfalfa, dehydrated in summer at a central plant from three or four larger farms, might be a good example. Another process might be to dry corn or sorghum in the fall, perhaps by the same dehydration unit as is used for the alfalfa. Another process might be the pressing of corn stalks into building panels.

By putting one or two economy industries together with several partial economies, this suggested to me, the phrase, the Partial Economy Industry Package.

### The Partial Economy Industry Package

Farms of 300 to 1000 acres in counties today are not hard to find. These farms are acquiring the necessary resources, interest and "know how" to demand Partial Economy Industry Package units as an adjunct to their farming operations. In fact, farmers, whether from the country or

city farmers, are working them out for themselves, in their own ingenious way. These industrial packages could serve to employ young men educated in business, management, agricultural engineering, and nutrition right back in the local areas from which they came.

One partial economy package might have an economy industry such as a central feed handling establishment, or a liquid fertilizer plant as its central core of operation. It could be surrounded with a dehydrator for seasonal conditioning of legumes and carbohydrates (corn and sorghums). Later in the season corn stalks might be gathered and pressed into panels to be utilized as sidings for smaller and possibly movable farm buildings, in conjunction with wood, aluminum or steel framework and roofing.

The feed unit could utilize its seasonally produced alfalfa from surrounding farms in feed processing. Vitamin premixes and soybean meal could be procured from outside sources. If volume of the business grew eventually meal might also be locally produced.

Another economy package might be illustrated by expanding the services of the above mentioned specialized egg economy industry to include: *(a)* Handling of bulk feed in conjunction with a feed mixing plant utilizing home produced grains; *(b)* Assistance as an intermediary in supplying needed credit (Possibly extension of Production Credit Association activities); *(c)* Own and operate a hatchery supply flock of highly productive birds; *(d)* Hatchery operations, and *(e)* Employ a farm production supervision to assist farmers on management and technology and *(f)* Employ a marketing specialist if the firm is big enough (or use consultation services).

Such economy packages present some real possibilities for development of rural areas. The efficiency dictates that these are coming in agriculture. Such light industry will not only reduce costs and expand returns to farmers but will also provide jobs for farmer's friends and neighbors in the small towns.

The partial economy packages like the first example are in reality stepped up derivatives of the country elevator with its variety of storage, feed and supply handling facilities. I would propose that they be changed both in form and location. By change of form I mean that the agricultural engineering in them should be highly intensified and highly refined for certain selected processes. Some services should be supplemented by process engineering. These processes should be ones lending themselves to materials farms produce and also can more fully utilize.

By change in location, the thought here is that farms are growing in scale enough in certain areas that more diffused service and supply entities (farm process engineering) are needed. Most farms are not large enough to be able to afford one processing unit, however, several farms could afford and well utilize farm processing units designed to fit a group of farms in keeping with the area agriculture.

The important thing about this partial economy package is that it should be developed from the rural area upward. This permits the farmer and his rural neighbors to capitalize on the hitherto unutilized raw materials in their area, to cut costs and expand the productive wealth in their own areas.

### Industrial Utilization of Farm Products

Recently the subject of industrial utilization of farm products has been revived and is before the public eye. If agricultural engineers can refine and expand the farm process engineering in these partial economy packages, they very possibly can set the stage for the technology to springboard agriculture into the industrial utilization of farm products.

We can well afford to work some of our best brains in this area as the horizons of farm integration are expanded. It will permit a healthful growth of our rapidly accelerating technology. It provides an outlet for the excess capacity of agriculture. It can provide renewable resources in our efforts to provide a better standard of living for all.

### Expansion of Research

The actual mechanics of more highly refined agricultural industries cannot take place without a forerunner of integrated research and planning. This research must be redirected or expanded both within and without the confines of our educational institutions.

Our land grant schools and the U. S. Department of Agriculture system need to redirect some of their research. This activity will of necessity be confined to the more fundamental research in both production and marketing in agriculture.

In the past too much inertia to solutions or problems has arisen due to traditional attitudes of engineers, economists and natural science specialists regarding the boundaries of their professional fields. It has caused a failure to see the forest for the trees. We need better coordinated staff work to give research perspective.

### Cooperative and Corporate Research

It is most difficult if not impossible for our land grant schools to encompass greater refinement of research for a single unit in industry or to encompass research for industrial utilization of farm products. In fact it is not their place to do so.

It is here that individuals, agricultural corporations or cooperatives are going to have to work out funds for research and expand the depth of secondary research and management. Private research foundations and other institutions have a place here.

The research on our farm problems must be undertaken on a foundation as wide as the problems themselves. This means undertaking both horizontal research within an agricultural industry as well as within other related segments of the industry. Further research must move vertically from production and selling through processing, wholesaling and retailing of a given commodity.

This will necessitate places for research in our U. S. Department of Agriculture system, in the affiliated land grant schools, in the given industry in its aggregate and finally private research agencies within the individual industry and firm themselves.

### Policy Implications

It is imperative that the three broad sets of problems confronting agriculture and spilling over into non-farm segments of agriculture be kept in mind together. I have mentioned here only a few suggestions for tackling the second set of problems confronting commercial agriculture.

The first set of problems have some solutions set forth for them in the better-farming, better-living program being advanced by the extension service.

The third set of problems possibly have some solutions getting under way through the President's Committee on Rural Development.

Solutions to these problems suggest that our farm policy of the future will be broadened and closely linked with our non-farm segment of agriculture and our suburban neighbors. All should broaden into a policy of area planning in the future with goals something like these:

1 Elimination of encroachment of individual freedom.

2 Increase efficiency.

3 Enable higher percentage of Americans to raise their own standard of living.

4 Provide minimum discomfitures from population shift.

#### Conclusion

In the future the status of America's commercial farmer fitting into the overall picture will depend on what the farmer does for himself. If he fits himself well into the picture he can contribute much to a better utilization of our country's human resources that are a part of our heritage and to a more satisfying and pleasant standard of living for himself as well as his neighbors.

## . . . Intense Rainfall

*(Continued from page 707)*

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## . . . Combine Performance

*(Continued from page 702)*

7 For harvesting barley under warm, dry, weather conditions, the cylinder-concave clearance should be relatively small (¼ in.) and the cylinder peripheral speed should be relatively high (5000 to 5500 fpm). However, the cylinder speed should not be high enough to cause objectionable damage to the seed.

8 Where walker losses tend to be high and threshing is not difficult, total seed losses will be minimized by having the concave grate open as much as possible so that maximum seed separation is obtained at this point.

9 Shoe free-seed losses increase rapidly if the amount of wind from the fan is either too low or too high. As the wind is increased there is a substantial and undesirable increase in the amount of free seed recirculated in the tailings.

10 At a given feed rate, the percentage shoe free-seed loss increases rapidly if the seed/straw ratio increases. Walker losses are not greatly affected by changes in the seed/straw ratio.

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## Message to Students

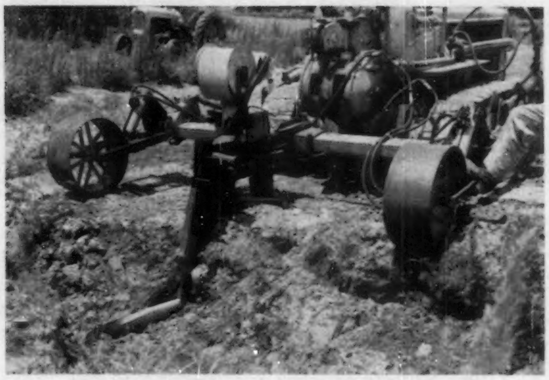
ATTENTION all agricultural engineering students. Coming soon is the Winter Meeting of the ASAE which will be held in Chicago again this year. This is a fine opportunity for all agricultural engineering students to attend a meeting of our parent society and get a first-hand observation of just how a professional society functions. Seniors in agricultural engineering would especially have much to gain from this meeting as there will be many excellent technical sessions to attend and also not overlooking the chance to meet men who are in a position to hire graduating engineers for their respective companies.

For this Winter Meeting we will find rooms available for us at the Palmer House at the rate of $3.50 per person and close by is the YMCA. Also close at hand will be eating places with prices in the $1.00 to $1.50 range for an adequate meal.

The date is December 17 to 19 and the place is the Palmer House in Chicago. The National ASAE office has mailed programs and registration forms to each student branch. We hope that you will come and take advantage of this excellent opportunity. See you in Chicago.

Robert L. Mensch, President
National Student Branch

# Machine Lays Plastic Drain



Perforated plastic assumes its round shape as it leaves tractor-pulled tile layer. At left water flows through a section of the plastic drain installed 30 in. deep

AFTER more than three years of research, trial-and-error, adjustment and testing, the Caterpillar Tractor Co. has devised a means of installing a ribbon of plastic material in the ground in tubular form for drainage of subsurface water.

To lay the plastic "tile" a spool of specially perforated sheet vinyl plastic is mounted on a subsoiler standard behind a tractor and is threaded through the shapers and directional changers of the tool. In operation the unit is lowered into the ground and installation takes place as the tractor moves across the field. It is reported that the directional changes of the plastic within the tool proved to be almost insurmountable problems during the years of work on the "tile layer."

The plastic tube laid by this technique goes into place in circular shape, similar to a pipe, and is 3 in. in diameter. This differs from earlier low-cost subsurface drainage devices which were plastic roofs on mole channels. The development at Caterpillar is an outgrowth and refinement of the plastic roof on mole channel work which was a cooperative project between Cornell University and the Soil and Water Conservation Research Division of the U.S. Department of Agriculture. See February 1958 issue of AGRICULTURAL ENGINEERING. Caterpillar technicians assisted and cooperated on the project at Cornell and are conducting studies also on the plastic roof technique. Several state colleges and U.S. Department of Agriculture facilities have cooperated in the new development by allowing the use of test plots for studies.

The material used to form the perforated tubular drain comes from flat sheet vinyl plastic, a development of the Bakelite Co. The plastic is formed into tubular shape in the tile layer tool. It holds its circular shape in the ground by *(a)* soil pressure, *(b)* metal stapling, *(c)* heat bonding, *(d)* pressure sensitive plastic tape, or *(e)* liquid fastening. All five methods of maintaining the round shape are said to be under further development.

A means of laying the plastic "tile" on grade is being studied. An electronic device for computing grade differentials and making necessary mechanical adjustments for uneven surface conditions is being considered.

## . . . Fifth Congress

*(Continued from page 691)*

investigated, however, before a decision is made—problems relating to facilities, publication of papers, tours, translation services, and, most important of all, financing. The Belgium hosts for the Fifth Congress established a precedent in service, hospitality, and entertainment that will be difficult to equal.

### Visits in England and Germany

Prior to the Fifth Congress, a delegation of U.S. agricultural engineers was privileged to visit research facilities in Volkenrode, Germany and Silsoe, England, and were guests of Massey-Ferguson Limited in Coventry.

The research activities at Volkenrode and Silsoe were quite outstanding and an extremely high percentage was remarkably similar to problems confronting agricultural engineers in the United States even though farming practices and customs are often quite different. Many of their research techniques were intriguingly different and original, and the visitors were impressed with the fundamental approaches used in seeking solutions to many complex agricultural engineering problems.

Preliminary discussions were held regarding the possibility of scheduling an ASAE tour to several European research and development centers. Perhaps enough members would be interested to make a special tour feasible by 1959 or 1960—and expenses are not as great as might be expected. This possibility will be investigated further.

Director Cashmore of the National Institute of Agricultural Engineering at Silsoe, and staff members McLaren, Hebblethwaite, Woodforde, Hawkins, Hamblin, Mamby and Hoare, as well as President Kostlin of the Forschungsanstalt fur Landwirtschaft at Volkenrode, and staff members Meyer, Kloth, Simons, Frese, Soehne, and Luckner were among those hosting the U.S. group.

An unusual opportunity was afforded ASAE representatives touring in England. Massey-Ferguson (Great Britain) Limited, through the efforts of Mr. Lionel Harper, Managing Director, and ASAE member John Chambers, served as hosts for a dinner and an extremely interesting tour of the firm's manufacturing and training facilities. In addition to the U.S. delegation, a number of British ASAE members, members of the Council of the Institution of British Agricultural Engineers, representatives of the Agricultural Engineers Association, Limited, and executives of The Standard Motor Company, Limited, and Massey-Ferguson Limited were present. Rarely does a touring group enjoy such an opportunity to meet so many of its counterparts in another country in so short a period of time. The morning program consisted of a tour of the automated assembly line of The Standard Motor Company plant in Coventry where certain M-F tractor components are made. During the afternoon the group toured the Massey-Ferguson training center for eastern hemisphere service personnel.

### First European ASAE Meeting

The first known European ASAE meeting was held between 12:00 and 2:00 p.m., Tuesday, September 30, 1958, in Brussels. Forty persons from four continents were present for the "Get-Acquainted" session. President E. G. McKibben addressed the group, and each person present introduced himself giving name, affiliation, work, and other pertinent introductory facts. The balance of the meeting was devoted to informal discussions and lunch.

# 1959 Nominations Announced

LAWRENCE H. SKROMME
*Nominee for President*

LLOYD W. HURLBUT
*Nominee for President-Elect*

Nominations for elective officers of the American Society of Agricultural Engineers for 1959-60, have been reported by the nominating committee, S. S. DeForest (chairman), J. R. Carreker, N. H. Curry, J. Roberts and Carlton Zink. Voting will be by letter ballot to be mailed to voting members in February. Closure of voting will be March 31. In addition to vacancies to be filled due to expiration of terms at the time of the Annual Meeting in June 1951, a president-elect will be chosen. The president-elect will serve on the Council one year before his term of office as president and one year as past-president. Changes in the coming election have been necessary as part of the transition in reorganization of the Council as provided in amendments to the ASAE Constitution which were approved in June 1958, and reported in the July issue of AGRICULTURAL ENGINEERING, page 418. Also in agreement with the transition plan, the term for councilor will be for two years and the president will serve on the Council for two years—only one year as past-president. Nominees include president, president-elect, councilor and five members of nominating committee as follows:

## Nominee for President

**Lawrence H. Skromme** was born on a farm near Roland, Iowa, on August 26, 1913. He developed an early interest in farm activities as an energetic member of the 4-H Club and the FFA. While holding membership in the former he earned a state journalism championship and became a scholarship winner in the state fair judging contest. He also gained a state farmer award as an FFA member. In 1931 he graduated from Kelley High School, Kelley, Iowa, and received a B.S. degree in agricultural engineering from Iowa State College in 1937, graduating with honors. He was elected to Alpha Zeta, Tau Beta Pi, and Phi Kappa Phi. His scholastic rating also earned him selection as a candidate for the Rhodes Scholarship to represent Iowa State.

After his graduation from college he was employed with the Goodyear Tire and Rubber Co. where he remained until 1941, working as a draftsman, designer, and a test engineer on farm tractor and implement tires. He accepted a position with Harry Ferguson, Inc. of Detroit, Mich. in 1941 where he worked as project engineer, later earning advancement to assistant chief engineer of farm tractors and implements. In 1951 he joined the staff at New Holland Machine Co., Division of Sperry Rand Corp., New Holland, Pa. where he presently holds the position of chief engineer of design and development of grassland farming equipment.

Mr. Skromme has been an active member of ASAE serving as national chairman of the ASAE Council of Student Branches, chairman of the Committee on Student Branches, member of Power and Machinery Division Steering Committee, chairman of the Committee on Technical Paper Awards, as vice-president and Council member of ASAE from 1952 to 1955, and as a Nominating Committee member of the North Atlantic Section. Along with his ASAE affiliation he holds membership in the American Society for Engineering Education, Farm Equipment Institute Engineering Advisory Committee, the Society of Automotive Engineers, Conestoga Valley Association, and the American Ordnance Association. He is also an active member of the Methodist Church.

Although Mr. Skromme owns a 280-acre farm in Buchanan County, Iowa, he is living on a small farm at 2150 Landis Valley Road, Lancaster, Pa., which he shares with his wife, the former Margaret E. Gleason, an Iowa State graduate in home economics, and their three daughters Cherlyn Sue, 15, Inga Jean, 14, and Karen Ann, 10. Along with his gardening hobby he collects antiques and early tools.

**Nominees for Vice-President**

E. W. SCHROEDER

J. G. SUTTON

## Nominee for President-Elect

**Lloyd W. Hurlbut** was born in Sylvan Grove, Kans., February 28, 1909. He received a B.S. degree in agricultural engineering from Kansas State College in 1932 and an M.S. degree from the University of Nebraska in 1934. He was employed in the agricultural engineering department at the University of Nebraska before beginning a term of service with the U.S. Navy from 1943 to 1945 as underwater sound detection officer. He joined the agricultural engineering staff at Purdue University after returning from service with the Navy. In 1947 he accepted the position of chairman of the agricultural engineering department, University of Nebraska, and still holds this position.


Mr. Hurlbut currently is serving as vice-president of ASAE and has served on the Educational and Research Division as chairman; as secretary, vice-chairman and chairman of the Mid-Central Section; as member on the National Joint Committee on Fertilizer Application, and the Power and Machinery Division Committee on Fertilizer Application; as chairman of the Motion Picture Production Committee; and as member of the Inspection Committee, Region 7, accrediting program, and Engineers Council for Professional Development.

He is also author or co-author of Journal articles dealing with comparative tests with rubber tires and steel wheels on farm tractors, equipment for mulch farming, harvesting and conditioning grain for storage, experimental harvester for castor seed, and combining corn.

Professional and scientific organizations in which he has membership include Sigma Tau, Sigma Xi, Gamma Sigma Delta, Steel Ring, American Society of Engineering Education, Nebraska Engineering Society, Lincoln Engineers Club, Nebraska Board of Tractor Test Engineers, and he is a registered professional engineer in Nebraska.

## Nominees for Vice-President

**E. W. Schroeder** was born in Fort Atkinson, Wis., in 1908, and did his undergraduate work in agricultural engineering at the University of Wisconsin by first obtaining a degree in agriculture in 1932 and an additional degree in mechanical engineering the following year. In 1942 he earned an M.S. degree in agricultural engineering from Pennsylvania State University.

From 1933 to 1936 he was employed with the U.S. Forestry and Soil Conservation Service in Wisconsin as junior and project engineer. In 1936 he accepted a position with the Pennsylvania State University as instructor in agricultural engineering. He remained in this position until 1946 when he accepted employment as head of farm machinery research with the T.V.A.

*(Continued on page 717)*

**Nominees for Councilor**

A. W. COOPER

C. G. E. DOWNING


J. P. SCHAENZER

H. L. CLEVENGER

S. E. DOWLING

W. P. ANNABLE

**J. P. Schaenzer** has been advanced to head up the technology department of the USDA Graduate School, Washington, D. C. Formerly he was chairman of the engineering division, which, with the divisions of surveying and mapping, fine and applied arts, and photography, make up the technology department. There are nine departments in the Graduate School and the chairmen of these and the director comprise the Graduate School Council. Enrollment for the 1957-58 year was 5900 students.

The Graduate School, through the technology department, offers to Federal employees courses designed to add to the technical, professional and administrative background of engineers. Many courses offered provide training in the latest techniques that colleges and technical institutions often cannot provide.

**H. L. Clevenger** has accepted an appointment as sales manager for Form-Crete products for the Florida Division of Food Machinery and Chemical Corp. He will make his headquarters in Lakeland, Florida. His territory will cover all the states east of the Rocky Mountains. Prior to this assignment he served as assistant to the general sales manager.

Mr. Clevenger is a graduate of the University of Texas with a B.S. degree in mechanical engineering. He joined Food Machinery Corp. in 1951 serving in various capacities as project engineer and sales engineer before assignment to the Form-Crete department.

**S. E. Dowling** has resigned his position as assistant agricultural engineer for the Florida Agricultural Extension Service to accept a position as Southeastern District sales manager for Rainy Sprinkler Sales, Peoria, Ill. Mr. Dowling will maintain his office in Gainesville, Florida, and will be assigned to six southeastern states. He will continue to serve as secretary of the Florida Section of ASAE.

**William P. Annable** has been appointed instructor of agricultural engineering in the farmstead engineering program at the University of Massachusetts. He is a 1955 graduate of the University of New Hampshire. After graduation he worked with the SCS in New York and has recently completed his military service. He plans to work toward an M.S. degree while serving on the staff at the University of Massachusetts.

**E. S. Bell** who has been with the General Electric Company for the past three years has accepted the position of associate professor in the agricultural engineering department of the Virginia Polytechnic Institute. Mr. Bell is a 1954 graduate of VPI,

## NECROLOGY

H. A. ARNOLD

N. H. RICH, JR.

**Harold A. Arnold,** associate agricultural engineer at the University of Tennessee, died October 5, 1958.

Mr. Arnold was born on a farm near Kiel, Wisconsin, March 5, 1898. In addition to a B.S. degree and an M.S. degree received at the University of Wisconsin and Iowa State College, respectively, he completed a 3-year course at River Falls Normal School in Wisconsin. He was employed for short periods by the International Harvester Co., the J. I. Case Co., the A. O. Smith Corp., and the Milwaukee Press and Machine Co. Before receiving his B.S. degree he taught science and mechanical arts in high school for four years in Wisconsin and for three years in Kansas. He first came to Tennessee in 1927, and was one of the first teachers of agricultural engineering at the University of Tennessee.

Beginning in 1933, Mr. Arnold worked with T.V.A. on contour cultivation of hillsides and on the development of lespedeza seed harvesters and small grain threshing machines. In 1938 he was employed by the University of Tennessee in the agricultural engineering department, where he concentrated on solving problems of harvesting, storing, and feeding hay and silage. He was one of the first agricultural engineers to start work on modern techniques of managing and handling hay and silage and became a national authority in this field. One of his most important contributions was the development of a hose pump for handling silage preservatives that later proved popular over the country for metering and distributing liquid fertilizers. He also developed a castor bean sheller.

He was listed in "American Men of Science" and was a registered professional engineer. He joined ASAE in 1927.

He is survived by his wife and two sons.

**Nathan H. Rich, Jr.,** professor of agricultural engineering at the University of Maine, died at the age of 42 on September 27, 1958 after a short illness due to a kidney infection.

Born at Charleston, Maine, July 16, 1916, he received a B. S. degree in mechanical engineering from the University of Maine in 1940. He joined the staff as an instructor in mechanical engineering in 1941 after one year in the engineering department of Farrel Foundry and Machine Co., Waterbury, Conn. In 1944 he was given a leave of absence to join the staff at the Thayer School of Engineering of Dartmouth College to aid in the Navy V-12 program there. He rejoined the staff in 1945 as an assistant professor in charge of agricultural engineering teaching in what was then the department of agronomy and agricultural engineering. During a sabbatical leave in 1952-1953 he was awarded an M.S. degree in agricultural engineering from Michigan State University for work on bunker silos.

His teaching activities have been in the field of farm power and rural electrification. Research under his direction consisted of forage handling work which resulted in designs and plans for uniform silage unloading devices and mechanical drying of dry shell beans. He carried on a testing program on electric fence controllers as required by Maine law under the department of Industrial Cooperation.

Under his direction the Maine Student Branch of ASAE won two consecutive (1956 and 1957) Group B Farm Equipment Institute trophies.

He was advisor to Phi Eta Kappa and a member of Sigma Pi Sigma Physic Honorary Society, the Masonic Lodge, ASEE, AAUP and the Methodist Church in Orono.

He is survived by his wife and three children. In expression of their esteem and sympathy, a number of his friends have established through the agricultural engineering department a fund for the college education of his children.

**Frank W. Bauling** died of a heart attack on the campus of the University of Illinois on August 15, 1958. He was one of the outstanding students to graduate in agricultural engineering at the University of Illinois, receiving a B.S. degree in June 1957. While in school he received class honors, college honors, and upon graduation received University honors for his high scholastic standing. In 1957 he was awarded one of the ASAE Student Honor Awards by his fellow members of the Illinois ASAE Student Branch. He had been active in Student Branch activities, serving as scribe, president and chairman of a number of special committees. He was elected to Phi Eta Sigma, Tau Beta Pi and Phi Kappa Phi honoraries.

Mr. Bauling was born August 16, 1935 in Beloit, Wis. At the time of his death he was working on an M.S. degree, majoring in farm structures, and was employed as a half-time assistant in the department of agricultural engineering. He planned to continue work for his Ph.D. degree.

receiving an M.S. degree from the same institution the following year. In his new assignment he will do research in electrical power and processing and will be working on peanut curing and apple processing projects.

**William Boss,** 89, former head of the agricultural engineering department, University of Minnesota, and charter member and past-president of ASAE, received the university's Outstanding Achievement Award Monday evening, October 27. Mr. Boss, who retired from the university in 1938, was an early leader in research and instruction on farm mechanization. The award was presented at the regular meeting of the Minnesota Section of ASAE by A. J. Olson, a Renville member of the university's Board of Regents.

Except for nine years before and during World War I, Mr. Boss was connected with the university from the time he enrolled as a student in the School of Agriculture in 1890 until his retirement. In 1909 he designed the building in which the department of agricultural engineering is housed. He was head of the department during his last 20 years at the university.

Forty years ago Mr. Boss developed the Specialty Manufacturing Co., St. Paul, and is now chairman of the company's Board of Directors.

In 1906 he wrote an instruction book for threshermen. He is also co-author of the text on "Mechanical Training," published in 1931.

Jamestown College, N. Dak., awarded him an honorary B.Sc. degree in 1956 and in 1957 he received an honorary D.Sc. degree from Macalester College, St. Paul, Minn.

**Richard E. Schleusener** has been appointed assistant research engineer and assistant professor in the College of Engineering, Colorado State University, where he received a Ph.D. degree in irrigation engineering in June. He was formerly on the agricultural engineering staff at Kansas State College. His current research is in hydrology and meteorology and is teaching agricultural engineering courses on drainage and irrigation. He received a B.S. degree in agricultural engineering at the University of Nebraska and an M.S. degree in agricultural engineering at Kansas State College.

**Deane G. Carter** retired September 1, after 17 years on the staff of the agricultural engineering department, University of Illinois, and more than 43 years of work in agricultural engineering. He received a B.S. degree in agricultural engineering from Iowa State College in 1915. Following graduation he joined the staff of the James Manufacturing Co. In September 1916, he took the first of a number of positions in the educational field at Iowa State College, remaining there until 1919 when he moved to North Carolina State College for one year. From 1920 to 1922 he operated a farm in Minnesota, then he returned to the teaching field, joining the staff of the agricultural engineering department at the University of Arkansas where he later became department head. In 1926 he completed the requirements for an M.S. degree at Iowa State College.

In 1941 he came to the University of Illinois where he was leader of the Farm Structures group until April 1956. At that time he joined the staff of the Provost's office to become coordinator of the University's contract programs with the International Cooperation Administration and remained in this post until his retirement.

## Three Retire from University of Illinois

The agricultural engineering department at the University of Illinois honored three staff members whose retirements became effective September 1. *(Above)* Professor and Mrs. Deane G. Carter were guests of honor at a garden party at the home of Professor and Mrs. Keith Hinchcliff July 31. At right *(Top and center)* Frank B. Lanham, head of agricultural engineering department, presents certificates of appreciation to Professors Arthur L. Young and Ray I. Shawl. Together Professors Shawl and Young had served the university for 75 years. *(Bottom)* Two couples, Professor and Mrs. Ray I. Shawl *(Left)* and Professor and Mrs. Arthur L. Young, *(Right)* shared the spotlight at a special retirement banquet June 4

During his professional career Mr. Carter was vice-president of ASAE, councilor, and chairman of the Farm Structures Division. He contributed a large number of articles to scientific journals and magazines and authored a number of experiment station bulletins and circulars. He also authored or co-authored a number of textbooks.

Mr. Carter was active in many organizations and societies, being a member of Tau Beta Pi, Alpha Zeta (High Council), Omicron Delta Kappa, Gamma Sigma Delta, Phi Kappa Phi, Sigma Xi, ISPE and the Lion's Club. He is a Life Fellow of ASAE. His plans for the future include activity in phases of writing, construction, and international programs. He and Mrs. Carter have moved to Fayetteville, Arkansas where they now reside.

**Ray I. Shawl** retired September 1, 1958, after serving 42 years on the staff of the department of agricultural engineering at the University of Illinois. He joined the department as an assistant in 1916 and except for a brief period of service in the Navy during World War I, served continuously on the staff until his retirement.

He received a B.S. degree in agriculture with specialization in agricultural engineering from the University of Illinois in 1915 and in 1919 earned an M.S. degree also from the University of Illinois. He specialized in teaching courses in farm tractors and farm machinery for students in agriculture and authored a number of articles and circulars on these subjects.

Mr. Shawl has been a member of ASAE since 1920. He also has membership in Gamma Sigma Delta, Ma-Wan-Da, Phi Mu Alpha and Acacia Fraternity.

He and Mrs. Shawl will continue to make their home in Urbana.

**Arthur L. Young** retired September 1, 1958, following 35 years of service to the agricultural engineering department at the University of Illinois. In 1912 Mr. Young received a B.S. degree from Parson's College in Fairfield, Iowa. He served in France during World War I and remained in Germany as a civilian employee of the Army. Upon returning from Europe he earned a second B.S. degree in mechanical engineering from Iowa State College in 1921 and an M.S. degree in agricultural engineering from the same institution in 1923. During the time he was working on his M.S. degree he taught mathematics. He joined the staff at the University of Illinois in 1923 and continued in the university's employ until his retirement. He taught a number of the service courses for students in agriculture and vocational agriculture and conducted research in farm power and farm machines.

In addition to ASAE membership, he is affiliated with ASEE, Phi Kappa Phi, Tau Beta Pi, and Gamma Sigma Delta. He and Mrs. Young will continue to make their home in Urbana.

**Ralph C. Hay,** professor of agricultural engineering at the University of Illinois, has taken over the duties of coordinator of the University's contract program with the International Cooperation Administration in the office of the Provost upon the retirement of Deane G. Carter.

**Fred E. Beckett** has returned to Louisiana Polytechnic Institute, Ruston, as associate professor of agricultural engineering after a leave of absence. He was recently graduated with a Ph.D. degree in agricultural engineering from Oklahoma State University.

**Robert V. Thurmond,** extension agricultural engineer, Irrigation, Texas Agricultural Extension Service, A. & M. College of Texas, has accepted a position with the Texas Board of Water Engineers.

# Winter Meeting Details

The 1958 Winter Meeting of the American Society of Agricultural Engineers will be held this year at the Palmer House Hotel in Chicago on Wednesday, Thursday and Friday, December 17-19, rather than during the first part of the week as has previously been the custom. The Palmer House location was decided upon because of the possible desirability of a down-town hotel where eating places and shopping districts are easily accessible and the location is convenient for those traveling by plane and train.

Registration will begin at 2:00 p.m. Tuesday, December 16, on the 4th Floor Foyer. Advance registration cards and hotel reservation forms have been mailed to ASAE members. Non-members interested in attending the meeting should communicate with the central office of the Society at St. Joseph, Mich., for information on accommodations and the program of the meeting sessions. A Cabinet Meeting will be held in Exhibition Hall at 7:00 p.m. on Tuesday, December 16. The Personnel Service Contact session, scheduled for 4:00 p.m. Wednesday, December 17, will meet in private dining room 17.

Regular sessions for Power and Machinery, Electric Power and Processing, Farm Structures, and Soil and Water Divisions will be held all day Wednesday, Thursday morning and all day Friday.

### General Session

The theme of the General Session, to take place on Thursday afternoon, December 18, at 1:30 p.m. will be "Operations Research." Three outstanding speakers, particularly selected to contribute to the program will include Dr. E. L. Butz, dean of agriculture, Purdue University, whose discussion will be entitled "Agriculture Today —A Synthesis of Techniques"; Dr. L. L. Sammett, department of agricultural economics, University of California, Berkeley, who will speak on "Systems Engineering in Agriculture," and Dr. T. E. Caywood, director, Operations Research Group, Caywood-Schiller Associates, Chicago, Ill., who will present "What Operations Research is Accomplishing for Industry."

### Research Seminar

The ASAE Committee on Research will sponsor a seminar at 7:00 p.m. Wednesday, December 17, entitled "Approach to a Research Problem." The topic, to be on factors affecting the approach to a research problem, will feature an opening speaker who will discuss the nature and complexity of the problem, break it down into segments, and cite the importance of cooperative industry-public service approach. A panel consisting of members of the sponsoring ASAE Research Committee will give brief commentary and answer questions from the floor. Moderators from public service and industry will accept questions from the floor, direct them to the panel members, and offer additional appropriate comments.

### Extension Program

The Extension program will be held Wednesday evening, December 17 at 8:00 p.m., in the Crystal Room. An address on techniques and materials for building models and exhibits will open the program with a demonstration and discussion by ASAE blue ribbon winners following.

### Farm Structures Milker

The Pure Milk Association and the American Dairy Association of Illinois will again co-sponsor the milk and cheese snacks which have become an important phase of the Farm Structures Milker which traditionally is held on the first afternoon of the Winter Meeting. This year's milker will feature a program on planning and use of visual aids and will be held in the Wabash Parlor of the Palmer House starting at 4:00 p.m. on Wednesday, December 17.

Robert S. Beeler, staff member of the sales service division of the Eastman Kodak Co. will be the speaker. Mr. Beeler has a rich experience in newspaper writing, educational radio work and the production and use of audiovisual materials with a particular slant to the agricultural field.

Before joining the Eastman Kodak Co., Mr. Beeler was associate agricultural extension editor and was on the faculty at the University of Wisconsin. He also taught press photography in the school of journalism. He was associated for a number of years also with the educational programs and editorial work of the colleges of agriculture at the Universities of Illinois and Wisconsin.

Mr. Beeler graduated from the University of Missouri with a B.S. degree in agricultural journalism and received an M.S. degree at the University of Wisconsin. He later was employed as a newspaper reporter and photographer by the Corn Belt Farm Dailies in Chicago.

As has been the custom in previous years, the Farm Structures Milker is planned by the division steering committee for the benefit of the whole Society membership and will be open to all divisions. In charge of this year's milker is W. Everett Eakin, farm promotion manager of Libbey-Owens-Ford Glass Co., assisted by Fred Kesler of Rilco Laminated Products, Inc.

## ASAE MEETINGS CALENDAR

November 14—QUAD CITY SECTION, American Legion Hall, Moline, Ill.

November 14 — OKLAHOMA SECTION, Oklahoma State University, Stillwater, Okla.

December 17-19 — WINTER MEETING, Palmer House, Chicago, Ill.

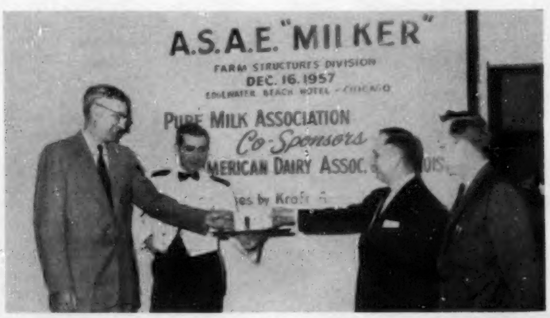
February 2-4 — SOUTHEAST SECTION, Memphis, Tenn.

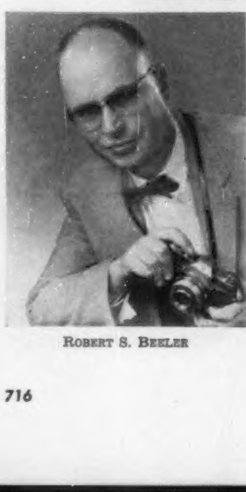
February 13 — MICHIGAN SECTION, Massey-Ferguson, Inc., 12601 Southfield Rd., Detroit, Mich.

April 3-4 — MID-CENTRAL SECTION, Hotel Robidoux, St. Joseph, Mo.

April 16-18 — FLORIDA SECTION, George Washington Hotel, West Palm Beach, Fla.

NOTE: Information on the above meetings, including copies of programs, etc., will be sent on request to ASAE, St. Joseph, Mich.



ROBERT S. BEELER

The Pure Milk Association and the American Dairy Association of Illinois will again co-sponsor the Farm Structures Milker during the Winter Meeting of ASAE, Wednesday evening, December 17. *(Above)* Milton Geuther, state manager of ADA of Illinois, O. R. Williams, Indiana Farm Bureau Coperative and Don Carlson, Illinois ADA field representative, prepare for milk toast during last year's Milker. *(Right)* Scene from 1957 Milker during Winter Meeting. *(Left)* This year Robert S. Beeler, staff member of the sales service division, Eastman Kodak Co. will be guest speaker.

## . . . Nominees

*(Continued from page 713)*

in Tennessee. In 1947 Mr. Schroeder was appointed to the agricultural engineering staff of Oklahoma State University where he presently heads the department.

He is author and co-author of several articles in the ASAE Journal, Experiment Station Bulletins and other articles in the area of farm power and machinery and soil and water conservation.

His ASAE activities include: vice-chairman and chairman of the College Division; chairman of the Committee on Graduate Instruction in which he organized and directed a graduate teaching seminar at the 1957 Annual Meeting; chairman, secretary and vice-chairman of the Southwest Section of ASAE; member of Committee on ASAE and ASEE relations; vice-chairman of Agricultural Engineering Division of ASEE; and program chairman of ASAE Annual Meeting in Houston, Texas. He organized the Oklahoma Section of ASAE. Other professional affiliations include president, Southern Association of Agricultural Engineering and Vocational Agricultural Educators; engineer on the Board of Directors Stillwater Conservancy District; collaborator, USDA Watershed Research, and Oklahoma Farm Electric Council, which he organized. He has played an important part in developing professional recognition of agricultural engineering in Oklahoma and the Southwest.

**John G. Sutton** was born in Gadsden, Alabama, and completed high school in the state. He graduated in 1924 from the University of California, majoring in irrigation engineering, with a B.S. degree in civil engineering. Following graduation he entered drainage and irrigation research work with the U.S. Department of Agriculture in 1925. His field assignments in this work were in Missouri, Louisiana and Illinois. From 1935 to 1939 he was in charge of operations of a maximum of 36 CCC drainage camps located in six midwestern states. In this assignment he served in the capacity of district engineer for the Bureau of Agricultural Engineering.

Since 1939 he has been with the Soil Conservation Service in Washington, D.C., and has had substantially the same assignment on drainage engineering operations since then. His present work is as staff specialist, drainage engineering, engineering division, Soil Conservation Service. He is author of numerous bulletins and articles on various phases of drainage.

He joined ASAE in 1927 and served as vice-chairman of the soil and water division in 1956 and chairman in 1957. He was chairman of the drainage group for several years prior to 1955. He has held numerous assignments as member and chairman of drainage committees since 1935.

In addition to his membership in ASAE, he holds membership in the American Society of Civil Engineers, American Society of Testing Materials, Soil Conservation Society, was elected to Sigma Xi, and is a registered professional engineer in the District of Columbia. He was elected to Who's Who in Engineering.

### Nominees for Councilor

**A. W. Cooper** was born in Fairfield, Ala., in 1918. He received both a B.S. degree and an M.S. degree in 1939 and 1941 respectively from Alabama Polytechnic Institute.

Following graduation in 1939 he accepted a position as instructor in the agricultural engineering department at Alabama Polytechnic Institute where he received subsequent advancement to associate professor. He remained on the staff until 1945. In 1946 after a tour of duty in the U.S. Navy he was placed in charge of farm electrification research, agricultural engineering department, Purdue University.

In 1949 he returned to Auburn, Ala., to become project supervisor with the Soil Conservation Service Research, USDA, and in 1953 was assigned to the post of agricultural engineer in connection with the USDA Tillage Machinery Laboratory Section. In 1954 he attended Michigan State University where he earned a Ph.D. degree and in 1956 he returned to Auburn to become assistant director of the National Tillage Machinery Laboratory. In February of 1958 he was named director.

Dr. Cooper has been a member of ASAE since 1939, serving as chairman and vice-chairman of the Alabama Section; vice-chairman of the Committee on Soil Compaction; a member of the Committee on Mulch Tillage; a member of the Committee on Technical Data; vice-chairman of the Southeast Section; and a member of the ASAE Inspection Committee, Accrediting Program, Engineers' Council for Professional Development. He received an ASAE Journal paper award in 1958 and was listed in Who's Who in the Midwest in 1948 and in Who's Who in the South and Southwest in 1956. He is a registered professional engineer in Alabama.

**C. Glenn E. Downing** was born May 1914 in Sceptre, Saskatchewan. In 1940 he graduated with a B.S. degree in agricultural engineering from the University of Saskatchewan. He held a position with the Experimental Farm at Swift Current, Saskatchewan while still in college and continued in their employ until 1942 in power and machinery testing and experimental work. One year was spent on irrigation ditch construction and maintenance with the Eastern Irrigation District at Brooks, Alta.

He served in the Royal Canadian Electrical and Mechanical Corps in Canada while in the Canadian Armed Service from 1942 to 1945, and after his return accepted an appointment to head the agricultural engineering department at the Ontario Agricultural College. During the time of his employment in this capacity he received a leave-of-absence to earn an M.S. degree from Iowa State College.

Mr. Downing has authored a number of papers on agricultural engineering and was an ASAE award winner in 1951. He is a past-chairman of the North Atlantic Section of ASAE, has been on the Animal Shelter Ventilation Committee, and has served as chairman of the ASAE Education and Research Division. He is presently agricultural engineer representative on the Ontario Conservation Council and for a number of years has been chairman, eastern division, of the National Committee on Agricultural Engineering in Canada.

Mr. Downing was instrumental in the development of the Canadian Farm Building Plan Service and has been active in the direction and supervision of its development. In 1957 he accepted an assignment with the F.A.O. of the United Nations in Chile, South America, to advise on the development of an agricultural engineering service and program with the Ministry of Agriculture and a university in Chile.

A member of ASAE since 1941, Mr. Downing also has membership in the Engineering Institute of Canada, Agricultural Institute of Canada, American Society for Engineering Education, and is a registered professional engineer in the Province of Ontario. He has been elected to Gamma Sigma Delta and Phi Kappa Phi.

### Nominees for Nominating Committee

#### Education and Research Division

**J. B. Rodgers,** head, agricultural engineering department, Oregon State College and agricultural engineer in charge of the Oregon Agricultural Experiment Station. He is a registered professional engineer in the state of Oregon and a member of Sigma Xi, secretary and project director of the Agricultural Engineering Research Foundation, and chairman of the Pacific Northwest Section of ASAE. *(Continued on page 718)*



## . . . Nominees

*(Continued from page 717)*

**G. E. Spencer,** head, agricultural engineering department, Purdue University. His activities in ASAE include, chairman, Education and Research Division of ASAE, member of the ASAE Meetings Committee, and official ASAE representative to the American Society for Engineering Education (member of ASEE General Council). He is a registered professional engineer in Indiana.

### Electric Power and Processing Division

**Ross Mauney,** manager, rural sales and development, Arkansas Power and Light Co. He has served ASAE as chairman of the Electric Power and Processing Division, chairman of the Southwest Section, and for a number of years on the Steering Committee of the Electric Power and Processing Division.

**Nolan Mitchell,** vice-president and director of sales, Aerovent Fan and Equipment Inc., Lansing, Mich. He has served on the following committees of ASAE: Steering Committee of the Electric Power and Processing Division, Committee on Animal Shelter Ventilation, Committee on Crop Drying Equipment, Committee on Agricultural Processing, Committee to Develop Uniform Terminology for Crop Drying, and chairman and vice-chairman of the Michigan Section.

### Farm Structures Division

**Merle L. Esmay,** professor and graduate advisor for the agricultural engineering department, Michigan State University. Recent activities in the Society include the completion of a term as chairman of the Farm Structures Division, preceded by a term as chairman of the Farm Structures Steering Committee. He has served as vice-chairman of the Michigan Section.

**R. E. Stewart,** professor of agricultural engineering, University of Missouri. He has been a member of ASAE since 1948, serving as treasurer of the Mid-Central Section, a member of the joint ASAE-ASHAE Technical Advisory Committee on Plant and Animal Industry, and a member of ASAE Research Committee. He is presently vice-chairman of the ASAE Research Committee.

### Power and Machinery Division

**C. S. Morrison,** manager, Product Development Department, Deere and Co. Recent activities in ASAE include serving as chairman of the Quad-City Section and chairman of the Power and Machinery Division. He has served also as member of the Committee on Research and E.C.P.D. Inspection.

**R. R. Poynor,** general supervisor, Farm Practice Research Section, Farm Equipment Product Planning Group, International Harvester Co. Activities in ASAE have been, chairman of the Soil and Water Division, a member of the Soil and Water Division Steering Committee. Recent committee assignments include membership on the Committee on Research, Graduate Instruction, E.C.P.D. Inspection, and Soil Compaction.

### Soil and Water Division

**R. K. Frevert,** director, Arizona Agricultural Experiment Station and professor of agricultural engineering, University of Arizona. Since becoming a member in 1938 he has served on several ASAE committees including the Committee on Depth and Spacing of Tile Drains, E.C.P.D. Inspection, and as Councilor on the Council of ASAE.

**A. J. Wojta,** associate professor of agricultural engineering and soils, soils department, and extension specialist in soil and water, University of Wisconsin. ASAE activities include chairman and vice-chairman of the Soil and Water Division, member and past-chairman of the division's Steering Committee, and chairman of Surface Drainage Committee.

## Correction

In error the listing on page 579, September issue, in the Materials Handling Product Directory number 37, representing E. W. Buschman Co., was placed under bucket conveyors. It should be listed, instead, under belt conveyors.

To avoid any misunderstanding concerning the research activities in feed handling at the University of Minnesota, page 582, September issue, it is reported that R. Larson is in charge of the Minnesota work, while John W. Rockey, Beltsville, Md., is in charge of the work done in the three states mentioned. It was also pointed out that the work in California has been extended beyond the 20 farms, as stated. They began with 22 farms in 1953 and have added many more with dairy studies continuing.

## PERSONNEL SERVICE BULLETIN

NOTE: In this bulletin, the following listings current and previously reported are not repeated in detail; for further information see the issue of AGRICULTURAL ENGINEERING indicated. "Agricultural Engineer" as used in these listings is not intended to imply any specific level of proficiency or registration as a professional engineer. Items published herein are summaries of mimeographed listings carried in the Personnel Service, copies of which will be furnished on request. To be listed in this Bulletin, request form for Personnel Service listing.

POSITIONS OPEN—MAY—O-129-814, 147-815, 69-817, 154-820, 159-822. JUNE—O-189-823, 194-824, 199-825, 200-826. JULY—O-256-827. AUGUST — O-276-830. SEPTEMBER — O-308-831. OCTOBER—O-321-832.

POSITIONS WANTED—MAY—W-25-20, 127-21, 128-22, 143-23. JUNE—W-175-26, 188-27, 79-28, 192-29, 172-30, 205-31. JULY—W-197-32, 246-33, 251-35. AUGUST — W-258-38, 236-39, 260-40, 261-41, 242-42, 271-43, 286-44, 285-45, 287-46. SEPTEMBER—W-279-47, 297-48, 299-49, 248-50. OCTOBER — W-314-52, 315-53, 322-54.

### NEW POSITIONS OPEN

CHIEF ENGINEER, heater and farm equipment division of established manufacturer in Midwest to head engineering activities with prime responsibility for developing new product lines in farm equipment. Age 30-40. BS in agricultural or mechanical engineering, with experience including responsibility for development of medium to heavy products. Should be a team worker able to accept and use ideas of others as well as his own. Salary $10,000 to $15,000, plus bonus. O-327-833

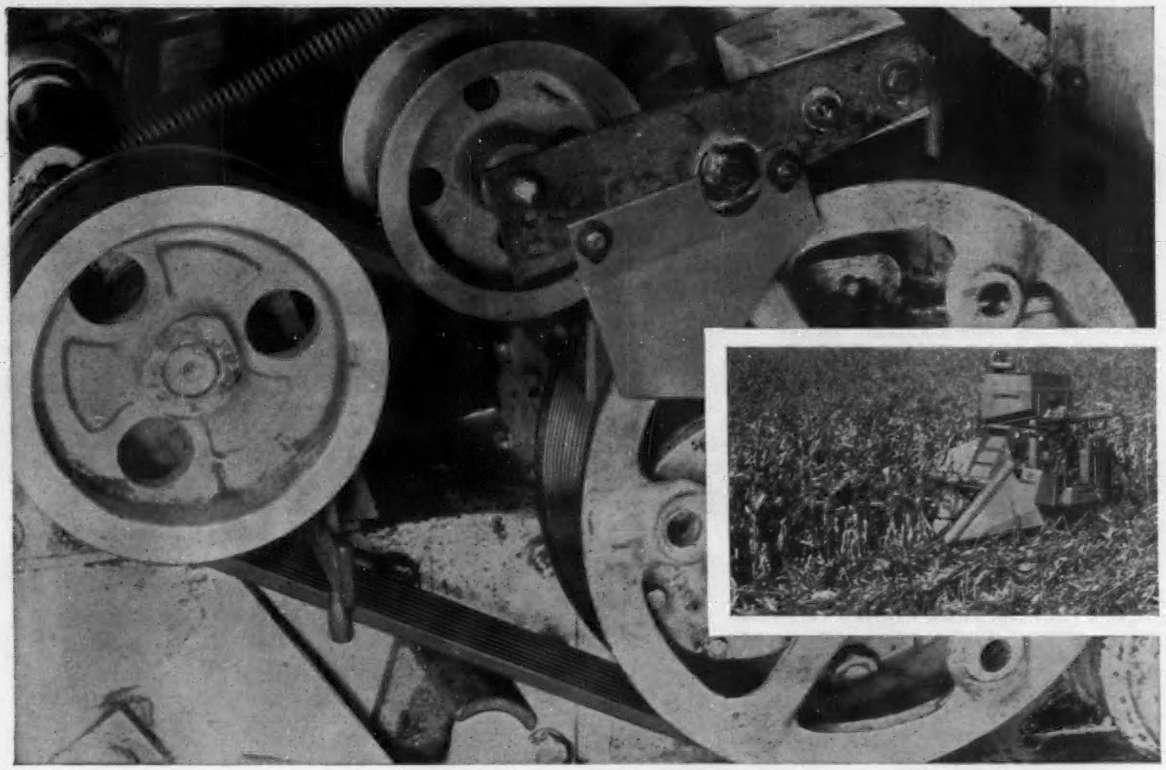
AGRICULTURAL ENGINEER for assistant to chief engineer of leading farm implement manufacturer. Must be experienced and proven in product design. To design and develop compatible line of farm implements, test new designs, do research and expansion of company product line. A real opportunity for the man who is capable and seasoned. Wisconsin location. Salary open. O-330-834

AGRICULTURAL ENGINEER for product development department of established farm equipment manufacturer. Work includes calling on public service research agencies and reporting on progress of research. Location, Midwest. BSAE. Experience in research or product development in farm power and machinery field desirable. Interest in product development and usual qualifications for personal contact work. Excellent opportunity for well qualified man. Salary open. O-331-835

AGRICULTURAL FIELD PROMOTION REPRESENTATIVES (3) for educational, development, promotion, and technical service work in agricultural market for a building material. Work involves personal calls on agricultural colleges, extension service, government agencies, rural lumber dealers, farm building fabricators and contractors, equipment manufacturers, feed and milling companies, farm cooperatives and farmer groups. Territory open in Southwest, South Central, and Southeast Age 28-40. BSAE, preferably with farm structures option. Must be professionally competent. Practical experience in agricultural engineering with emphasis on farm structures or near related field. Must have genuine interest in farm structures field and enjoy public and personal contact work. Mature approach to solution of problems essential. Must expect reasonable amount of travel. Excellent opportunity for qualified men willing to work. Personal and professional development recognized. Salary open. O-340-836

AGRICULTURAL ENGINEER (instructor to professor rank, according to qualifications) to take charge of power and machinery courses and research in handling equipment at a northeastern land grant university with a professional curriculum. MSAE or BSAE and genuine desire to do graduate work. PhD desirable. Interest in college teaching and research. Able to work well with young and energetic staff dedicated to building a strong department. Teaching and research experience desirable. Excellent opportunity for advancement in one of the youngest and fastest growing departments in the east, with over 60 professional students. Usual Social Security, life and health insurance. Outstanding retirement plan. Salary open. O-343-837

DISTRICT SALES MANAGER to handle sales of agricultural and light industrial equipment to retail dealers, for established wholesale distributor. Location, central Pennsylvania, near Altoona. Age 25-45. Agricultural engineering training. Prefer married man. Wholesale agricultural sales experience desirable.
*(Continued on page 722)*



## . . . Personnel Service

*(Continued from page 720)*

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**NEW POSITIONS WANTED**

AGRICULTURAL ENGINEER for development, teaching, sales, or management in power and machinery, rural electric or product processing field with industry or public service. Any location. Willing to travel. Married. Age 35. No disability. MSAE, Michigan State University. College teaching 2 years. Sales and management with large manufacturer of wheel and track-type tractors, 7 years. War service in European Theatre of Operations. Available on reasonable notice. Salary open. W-332-55

AGRICULTURAL ENGINEER for extension, research, sales, service or writing in power and machinery field with college, manufacturer, or distributor, preferably in Midwest, West, or South. Willing to travel. Single. Age 27. No disability. BSAE, 1955, Ohio State University. Farm background. Summer work experience in drafting with farm equipment manufacturer. Design engineer with State Agriculture Department. USAF, 34 months commissioned service, mostly as pilot. Some maintenance engineering experience. Available now. W-324-56

AGRICULTURAL DEVELOPMENT man for extension, teaching, research, product promotion, and development on manufacturing level or in the field, in power and machinery with manufacturer, anywhere in USA. Foreign location considered. Married. Age 35. No disability. BSA, 1952, University of Wisconsin. County agricultural agent, 5 years. Trade association, one year in agricultural relations, committee activities, surveys, and special projects. War non-commissioned experience with paratroops. Available on reasonable notice. Salary $8,000. W-325-57

AGRICULTURAL ENGINEER for design, development, research or writing, in farm structures or power and machinery with a small company. Industry. Any location. Occasional travel. Married. Age 24. No disability. BSAE, 1956, University of Maine. Part-time extension work in college, testing tractors and equipment. Military experience 6 months, assistant to facilities engineer at Army proving grounds. Available on reasonable notice. Salary $7,500. W-335-58

SOIL CONSERVATION specialist for development, extension, and research in soil and water or crop raising with manufacturer, processor, consultant, farming operation, or canning industry. Midwest location preferred. Single. No disability. BS degree in soil conservation from College at Arnhem, Netherlands, 1957. Farm employment 12 months. Soil exploration, classification and testing 6 months. Military service 22 months, Royal Dutch Air Force. Available on two weeks notice. Salary $350 to $400 per month. W-339-59

AGRICULTURAL ENGINEER for development, extension, or research in power and machinery in public service or with trade association, preferably in Southeast. Married. Age 23. No disability. BSAE, 1957, from a southern university. Farm background including successful 4-H experience. Completed one-year company training program in engineering. Available on reasonable notice. Salary $6,000. W-318-60




The following bulletins have been released recently. Copies may be obtained by writing to author or institution listed with each.

*How to Build a Water Treatment System,* Rural Electrification 17, by Ralph I. Lipper, Thomas H. Lord, and Harold E. Stover. Extension Service, Kansas State College, Manhattan, Kansas.

*Hog Farrowing Houses and Equipment,* Circular 780, by E. L. Hansen and Arthur J. Muehling. Extension Service in Agriculture and Home Economics, College of Agriculture, University of Illinois, Urbana, Ill.

*Baled, Wafered, and Pelleted Hay,* by I. R. Jones, B. F. Magill and R. G. Petersen. May 1958. Agricultural Experiment Station, Oregon State College, Corvallis.

*An Instrument Designed to Give a Range of Soil Compactions for Laboratory and Greenhouse Investigations,* by George W. French and F. W. Snyder. Article 41-22, August 1958. Reprinted from the Quarterly Bulletin of the Michigan Agricultural Experiment Station. Agricultural Experiment Station, Michigan State University, East Lansing.

*Pressure Creosoted Douglas Fir Timber Foundation Piles for Permanent Structures,* issued by Western Wood Preserving Operators Association, 1410 S. W. Morrison St., Portland 5, Oregon.

*Bibliography on Electric and Related Equipment for Livestock Production and Feeding,* compiled by Donald R. Mackay. ARS 42-22, August, 1958. United States Department of Agriculture, Research Service, Washington, D. C.

*Equipment Used by Deciduous Fruit Growers in Handling Bulk Boxes,* by J. H. Levin and H. P. Gaston. ARS 42-20, August 1958. Fruit and Vegetable Harvest Section, Agricultural Engineering Research Division, USDA, Agricultural Engineering Department, Michigan State University, East Lansing, Mich.

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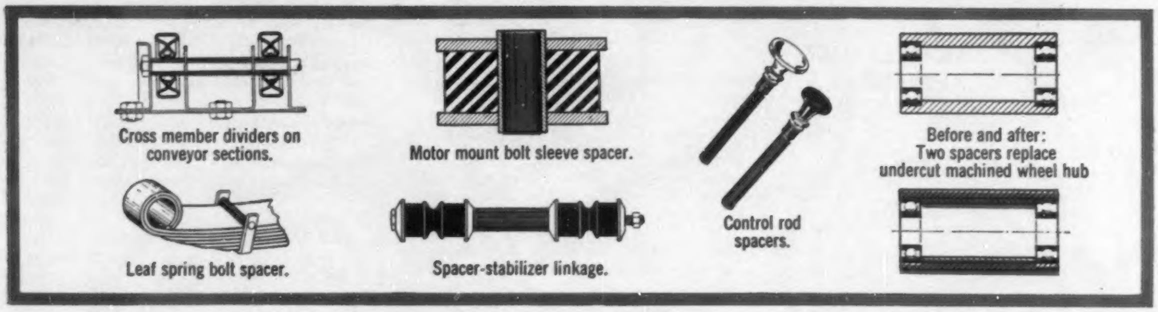


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The following is a list of recent applicants for membership in the American Society of Agricultural Engineers. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

**Aden, Wilburn** — Agr. engr., (SCS) USDA. (Mail) Rm. 209 Frankland Bldg., Jackson, Tenn.

**Austin, Vincent**—Head of dept. of technical subjects, 85 Irchester Rd., Wollaston, Wellingborough, Northants, England

**Bassett, Lawrence B.** — Soil conservationist, Navy Dept., District Public Works. (Mail) 2005 Sunset Ave., Waukegan, Ill.

**Bennett, Milton C.**—Field engr., J. I. Case Co., 700 State St., Racine, Wis.

**Carlson, Axel R.**—Ext. agr. engr., Pennsylvania State Univ., 108 Agricultural Engineering Bldg., University Park, Pa.

**Dekker, Herman E.**—Spec. asst. for soil conservation, District Public Works, 12th Naval Dist., Navy Dept., 12ND, San Bruno, Calif.

**Denton, Robert F., Jr.**—Tech. dir., Jamieson Laboratories, 2200 Colorado Ave., Santa Monica, Calif.

**Doggett, James N.**—Des. engr., Food Machinery & Chemical Corp. (Mail) 6672 Wisteria Way, San Jose, Calif.

**Dunkley, Hugh F.**—Surveyors aide, Lawrence Stowers. (Mail) Main St., Salem, N. H.

**Fitzgerald, Gerald A.**—Ext. food engr., Univ. of Massachusetts, agr. eng. dept., Amherst, Mass.

**George, Frank G.**—Owner, Frank G. George Architect, 119 N. 4th St., Palatka, Fla.

**Gharat, Ganesh K.** — Lecturer, College of Agriculture, Poona, Bombay State, India. (Mail) 1321½ Anderson Ave., Manhattan, Kans.

**Grossman, Seth S.**—Res. engr., International Harvester Co., 5225 S. Western Blvd., Chicago 9, Ill.

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**Jensen, Niels P.**—Physicist, Jamieson Laboratories, 2200 Colorado Ave., Santa Monica, Calif.

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**Nielson, LaVern,** Salesman, Warp Bros., 1100 No. Cicero, Chicago, Ill.

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**Smith, Erwin L.** — Chief engr., Clay Equipment Corp. (Mail) 503 Walnut St., Cedar Falls, Iowa

**Stoltenberg, Norval L.** — Special asst., District Public Works Office, 13th Naval District. (Mail) 15304 Interlake Ave., Seattle 33, Wash.

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**Terbush, Leo S.**—Special asst., District Public Works Office, U. S. Navy Dept. (Mail) 3137-B General Meyer Ave., New Orleans 14, La.

*(Continued on page 728)*

# ADVANTAGES OF FLEXIBLE SHAFTING

## For Power Drive and Remote Control

by C. Hotchkiss, Jr.

*Application Engineer,*

Stow Manufacturing Company

Flexible shafting has the following advantages over other type drives:

1 – It is often the simplest method of transmitting power between two points which are not collinear or which have relative motion

2 – eliminates exposed revolving parts

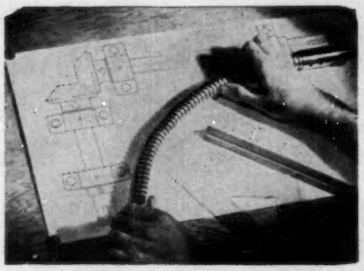
3 – does not require accurate alignment

4 – easy to install and maintain.

**NOT COLLINEAR** – Where it is necessary to connect two shafts which are not collinear, a simple arrangement of a single belt or two universal joints will often do the job adequately. But, in many cases where the path of transmission is more complicated and would require a more expensive arrangement of mechanical components, flexible shafting provides a simple, low cost, efficient drive which is easy to install because it does not require accurate alignment. See example, figure 1, in which a 1¼-inch Stow flexible shaft is used to drive the auger on a G.L.F. bulk feed truck.

Flexible shafting also allows the designer greater freedom in locating either the drive or the driven component on a piece of equipment.


Fig. 1



**RELATIVE MOTION** – Where two shafts which have relative motion must be connected, flexible shafting is often the ideal means of transmission. In many cases it eliminates a much more complicated drive which would, necessarily, include telescopic joints; further, it eliminates the danger of exposed moving parts. See figure 2, which shows a ¾-inch Stow flexible shaft driving an Avery Rake built by the Minneapolis Moline Co.

Fig. 2

Other typical applications of this type are used on portable power tools when motors are too heavy to be mounted on the tool – such as portable grinders, sanders, paint scrapers, saws and tree tappers. And, since flexible shafting is not affected by vibration, it is an ideal drive for applications where a high degree of vibration is involved – such as in vibration testing tables and concrete vibrators.

Stow flexible shafts are available: for power drive applications in diameter sizes from ⅛ inch to 1¼ inches; for remote control applications in diameter sizes from ⅛ inch to 1⅜ inches.

The 1¼ inch power drive shaft will transmit up to 10 HP while the 1⅜ inch remote control shaft will transmit up to 4000 lb. in.

For complete engineering data on flexible shafting, including selection charts, write for engineering bulletin 570.

**STOW MANUFACTURING COMPANY**

**39 SHEAR STREET • BINGHAMTON, NEW YORK**


**Cotton,** by Harry Bates Brown and Jacob Osborn Ware. Cloth, 6¼ x 9¼, x+566 pages, illustrated and indexed. Published by McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 36, N.Y. $12.00.

A third edition, the book traces cotton from the field to its finished product, points up its technological importance in the field of all textile fibers, and emphasizes its great value to the economy of the United States and the world.

It opens with a historical and geographic treatment of the subject. Then follows a discussion of the cotton plant in various relationships—its botanical species, commercially cultivated varieties, morphology and genetics. Next there is a discussion of subjects relating to cotton production — cotton breeding, diseases, insects, chemistry, physiology, climate, soils, fertilizers, culture, harvesting, and ginning. This is followed by a review of the phases of cotton marketing—cotton fiber technology, classing, cotton marketing proper, and the cotton future exchanges.

**Profile of Farm Mechanization in Japan,** by Shin Norin Sha. Cloth, 7¼ x 10¼ inches, 184 pages. Published by Shin-Norin-Sha, Ltd., Kanda Nishikicho 2 — chome, Chiyodaku, Tokyo, Japan.

This is a collection of photographs from various agricultural areas illustrating agricultural achievements in Japan, treating cultivation of the country's most important crops, rice and wheat. Written in Japanese with English translation.

## . . . Membership Applicants

*(Continued from page 726)*

**West, Thomas E.**—Rural rep., Virginia Electric and Power Co., Charlottesville, Va.

**Weaver, Marion M.** — Civil engr. (SCS) USDA. (Mail) R.R. 2, Waterloo, N. Y.

**Whitesell, David F.**—Elec. dev. engr., Meriwether Lewis Electric Co-op. (Mail) 134 Columbia Ave., Centerville, Tenn.

**TRANSFER OF MEMBERSHIP**

**Geiger, M. Lynne**—Res. engr., Tractor and Implement Div., Ford Motor Co. (Mail) 1746 Bowers, Birmingham, Mich. (Associate Member to Member)

**Muehling, Arthur J.**—Res. assoc., agr. eng. dept., Univ. of Illinois, Urbana, Ill. (Associate Member to Member)

**STUDENT TRANSFERS**

**Adams, John G., Jr.**—(Texas Technological College) (SCS) USDA, Veterans Bldg., Lubbock, Tex.

**Cagle, Wesley J.** — (Texas Technological College). (Mail) R.R. 1, Plainview, Tex.

**Moody, Wendell B.** — (Texas Technological College) (SCS) USDA, Big Spring Tex.

**Ochs, Richard L.**—(Texas Technological College). (Mail) c/o Fred W. Rabe, P.O. Box 2727, Dallas 21, Texas

**Van Buskirk, Daniel** — (Purdue Univ.). (Mail) Pedamar Farm, Roann, Ind.

**Wait, John C.** — (Univ. of Arkansas) Agr. engr., (SCS) USDA. (Mail) 2612 Anita Dr., Garland, Tex.

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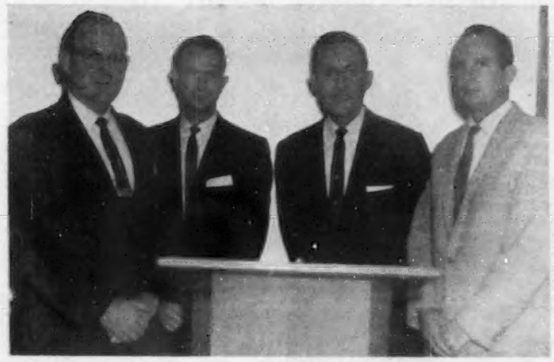

The following new officers were elected during the Tennessee Section meeting held October 3 and 4: *(Left to right)* W. C. Whisenant, TVA, Nashville, vice-chairman; George T. Hardy, International Harvester Co., vice-chairman; Clarence W. Bockhop, head of agricultural engineering, University of Tennessee, chairman; and J. K. Jones, National Cotton Council is past-chairman. Curtis Shelton, newly-elected secretary-treasurer is not shown

Officers selected to head the newly-organized Kentucky Section are: *(Left to right)* John M. Burns, state conservation engineer, chairman; T. C. Shirley, Kentucky State Association of Rural Electric Cooperatives, program vice-chairman; C. K. Kline, extension agricultural engineer, membership vice-chairman; B. F. Parker, acting head of agricultural engineering, University of Kentucky, public relations vice-chairman; and A. T. Smith, SCS, secretary-treasurer. At right is J. L. Butt, executive secretary of ASAE


### Kentucky Section Organized

The Kentucky Section was organized October 11, 1958, at the agricultural engineering department on the campus of the University of Kentucky with 23 in attendance. The by-laws were amended and adopted and officers were elected. Jimmy L. Butt, executive secretary of ASAE, addressed the newly organized section, giving the history, function, and activities of other state and regional sections.

The guests and their wives were included in the dinner that followed the organizational meeting which featured Mr. Penny Ecton, president of the Lexington Chamber of Commerce and an International Harvester farm machinery dealer, as speaker. His address which was both interesting and entertaining was entitled "Wherewith Agricultural Engineering in Kentucky Agriculture." The Kentucky-Auburn football game was the evening entertainment attraction.

Officers for the Kentucky Section are: chairman, J. M. Burns, state conservation engineer, Soil Conservation Service, Lexington; program vice-chairman, T. C. Shirley, agricultural engineer, Kentucky State Association of Rural Electric Coops., Louisville; membership vice-chairman, C. K. Kline, extension agricultural engineer, University of Kentucky; public relations vice-chairman, B. F. Parker, acting head, agricultural engineering department, University of Kentucky, and secretary-treasurer, A. T. Smith, agricultural engineer, Soil Conservation Service, Cynthiana.

### Tennessee Section

The Tennessee Section met October 3-4 for their annual meeting in Hotel Chisca in Memphis with 65 members and guests in attendance. Chairman J. K. Jones reports that over 300 invitations were mailed out before the meeting and press releases were mailed to 96 daily newspapers in Tennessee, Arkansas and Mississippi. Stories were carried by two Memphis papers for two days prior to the meeting, with articles in both papers during the meeting. Two speakers were on separate television programs Friday morning, Oct. 3, before the meeting began.

The presentations given during the Friday afternoon session discussed the future of agriculture in the Mid-South, the role of agricultural engineering in cotton mechanization, proposals for water rights legislation in Tennessee, the free-piston engine, field pelletizing equipment, hay conditioning and storage, new lubricants for agricultural use, and saving labor with materials handling equipment. The Friday evening banquet featured J. W. Borden, vice-president and sales manager, Eversman Mfg. Co., Denver, Colo. and vice-president of ASAE, as speaker. Saturday morning papers were on the use of solid set sprinkler systems and land leveling for drainage. A discussion of the extension engineering program for the state of Tennessee followed.

During the business meeting it was approved that the Section support an active educational program at the high school level to interest more young people in agricultural engineering. The Section also voted to offer $25.00 in financial assistance to an outstanding agricultural engineering student from the University of Tennessee to attend the national summer meeting each year and to extend an invitation to the council of ASAE to hold an annual meeting in Memphis. The following officers were elected for the new year: chairman, C. W. Bockhop; vice-chairman, W. C. Whisenant; vice-chairman, G. T. Hardy, and secretary-treasurer, Curtis Shelton.

## EVENTS CALENDAR

November 18-20 — *The 9th National Conference on Standards,* Hotel Roosevelt, New York, N. Y. For details write to American Standards Assn., Inc., 70 East 45th St., New York 17, N. Y.

December 1-5 — *1958 Annual Meeting of the American Society of Mechanical Engineers,* Hotels Statler-Hilton and Sheraton-McAlpin, New York, N. Y. For details write ASME, 29 W. 39th St., New York 18, N. Y.

December 3-5 — Eighth Annual Convention and Trade Show of the *Agricultural Ammonia Institute,* Morrison Hotel, Chicago. Write to J. F. Criswell, AAI, Claridge Hotel, Memphis Tenn., for information.

December 4 — *Farm Structures Day,* Agricultural Engineering Dept., University of Illinois. Write to D. G. Jedele, Agricultural Engineering Dept., University of Illinois, Urbana.

December 8-13 — *Dairy Industries Exposition,* on Navy Pier, Chicago. For details write to Dairy Industries Supply Association, 1145 19th St., N.W., Washington 6, D.C.

December 10-11 — *4th National Construction Industry Conference,* Hotel Sherman, Chicago, Ill. Reservation forms available from M. J. Jans, Armour Research Foundation, 10 W. 35th St., Chicago 16, Ill.

December 17-18 — *1958 Beltwide Cotton Production Conference,* Rice Hotel, Houston, Tex. Contact E. E. Robinson, National Cotton Council of America, P.O. Box 9905, Memphis 12, Tenn.

December 29-30 — Section M—Engineering portion of Annual Meeting of the *American Association for the Advancement of Science,* Hotel Statler, Washington, D.C. Program available after October 15 from Secretary, Section M, c/o E. J. C., 29 West 39th St., New York 18, N. Y.

January 26-27 — *First Annual ASLE Gear Symposium,* Morrison Hotel, Chicago, Ill. For further information write to American Society of Lubrication Engineers, 84 E. Randolph St., Chicago 1, Ill.

February 2-4 — 1959 Meeting of the *Association of Southern Agricultural Workers* —Agronomy Section, Memphis, Tenn., at the Peabody Hotel. Contact Louis N. Wise, Secretary, Agronomy Section, Agronomy Dept., Mississippi State University, State College, Miss., for details.

February 4-6—*Home Improvement Products Show* at the Coliseum, New York, N. Y. For further details write Ted Black, Public Relations, Medical Art Bldg., Reading, Pa.

February 8-14 — Observance of *National Electrical Week.* For additional information write to R. J. Gingles, 290 Madison Ave., New York 17, N. Y.

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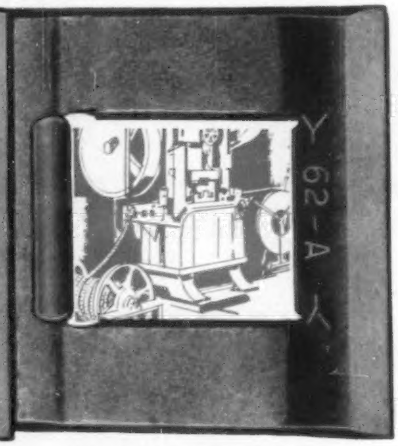


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**SPARK-TESTING** makes sure each coil of steel is of the same analysis as the steel checked in chemical inspection. The spark pattern reveals characteristics of the steel.

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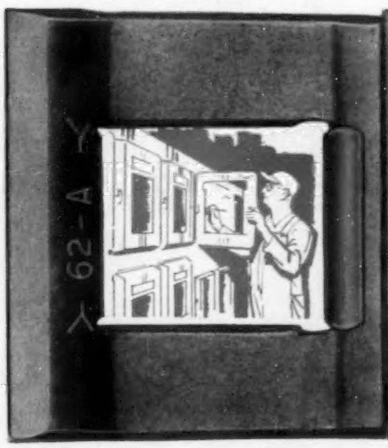



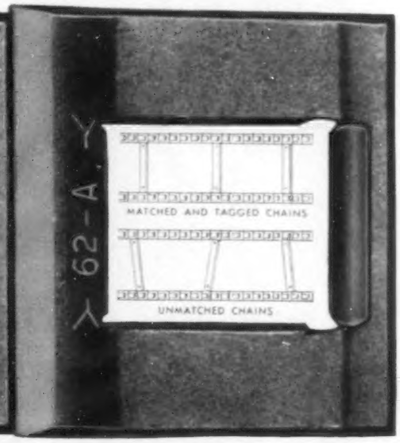


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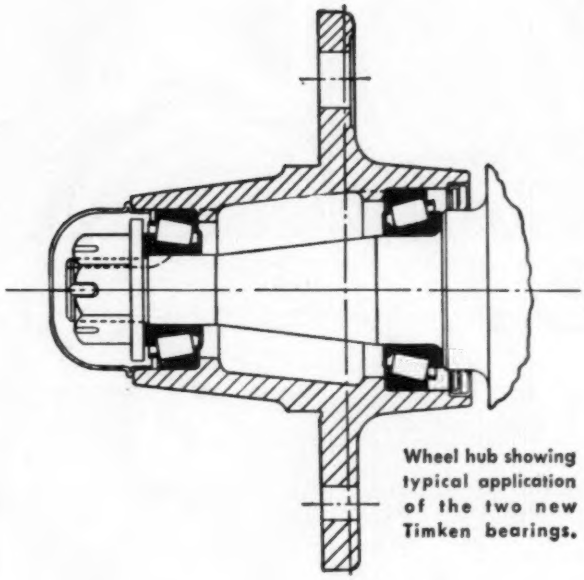
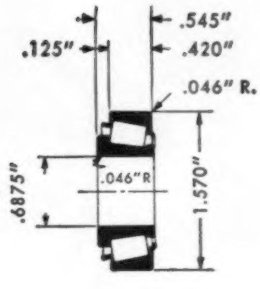
***Bore sizes 1.0625" and .6875" offer high capacity in less space --opportunity to save on related parts***



**Wheel hub showing typical application of the two new Timken bearings.**

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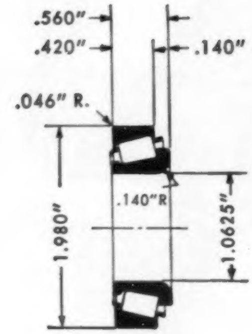


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WITH the two new small size Timken® bearings shown above, designers of farm implements can now get the advantages of roller bearings where they couldn't be used before. The small bearings pack high capacity in little space and they're lower in cost. They permit more compact designs, keeping related parts smaller—provide additional savings in hub materials, seals, nuts and dust caps, etc.

The inner bearing weighs about four oz. (.256 lb.). The outer bearing weighs less than three oz. (.181 lb.). They're the most economical single row Timken bearings ever produced in these bore sizes. Developed originally for use in small economical automobiles, they can be used wherever there is a need for an economical bearing in this size range (11/16" and 1 1/16" bore).

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